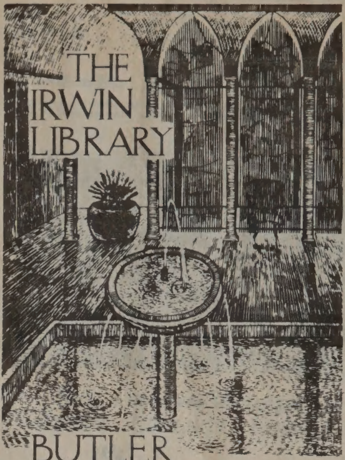

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THE AMATEUR MECHANIC

THE AMATEUR MECHANIC

A PRACTICAL GUIDE FOR THE HANDYMAN

EDITED BY
BERNARD E. JONES
EDITOR OF "WORK"

NEW, ENLARGED EDITION REARRANGED AND
ENTIRELY RESET

With Thousands of Photographs and Drawings

Vol. I

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Printed in Great Britain

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Preface to New Edition

A GLANCE through the following pages reveals the obvious aim and purpose of this work, namely, to provide the amateur mechanic with a complete self-instructor, bright and readable, reliable, well-illustrated, and up-to-date. It is a comprehensive guide to home handicraft and domestic jobbing, instructing its readers in scores of practical arts and crafts, and explaining suitable but eminently workmanlike methods of doing a hundred and one mechanical jobs about the house.

In this, the second, edition of a work that has now become famous, I have made certain alterations that will, I feel sure, commend themselves to my readers. In the light of further experience I have rearranged the whole of the contents of these volumes; I have revised all chapters which the passing of a few years had rendered out-of-date; I have compressed the treatment of the lesser subjects, and have also added pages to the work that I might make room for a large proportion of matter relating to new and more important subjects; and, in general, I have done my best to avail myself of the very many helpful suggestions which appreciative readers have kindly sent me.

Both as regards its subject-matter and the method and style of its presentation, this new edition will, it is confidently expected, be regarded with favour. My desire has been to make the way plain to all, especially to the new-comer, and with that end in view the instruction has been couched in simple, straightforward, and non-technical language, easily understood by everybody.

The remarkable teaching power of really good illustrations has, naturally, not been overlooked in the preparation of this work. Indeed, the reader will early find that as much as possible has been left to the photographs, drawings, and diagrams with which the pages are generously illustrated, and which have been relied upon not only to elucidate the text, but in themselves to convey lessons which words alone could impart only with difficulty.

The reader has a notable advantage in seeking to apply the instructions given in the following pages. Although everything has been done that could be done to prevent misunderstanding, it is well known that every amateur mechanic who learns from printed instructions is liable to stumble against peculiar difficulties of his own which no amount of foresight could have obviated. Any reader who encounters technical or practical difficulty may cheer himself with the knowledge that help is his for the asking. The columns of "Work" (the illustrated weekly journal that treats of practical matters from the standpoint of the amateur mechanic) are always open to expert and well-informed replies to questions. Therefore, all the inquirer need do is to send the undersigned a concise statement of his difficulty, confident that a reply will appear in "Work" as soon as possible after its receipt from the contributor to whom the query has been entrusted. It is earnestly hoped that all readers who meet with difficulties will avail themselves of this source of willing help.

BERNARD E. JONES.

La Belle Sauvage,
London, E.C.4.

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Woodworking: Outfit, Sawing and Planing

THIS chapter, and others to appear later in these volumes, will provide simple instruction in woodworking, the photographs and drawings of the tools, appliances, and operations being largely relied upon to impart information. It will be assumed that the worker is starting with a small kit of tools, to which he will add as his ability and skill increase. At first, then, only a few of the tools in general use will have their uses explained, although it is convenient to present in this chapter a set of illustrations (forty-eight in all) showing the majority of the hand tools with the uses of which the experienced worker will need to be familiar.

The Bench.—This, of course, is the principal piece of apparatus, as no planing, paring, or other processes can be properly done without it. To those who can afford to buy a bench already made and fitted with a vice complete, the purchase of a bench with a tail vice and spring stops is advised; these stops are extremely useful for holding pieces of wood in position. In addition, a side vice, while involving a slight additional expense, saves time, labour, and trouble. Fig. 1 shows a small bench in which the screw with the cheek and runner can be used both for the purpose of a side vice and tail vice. The lower part of a bench of this design can be provided with a bottom shelf and one or more others boarded round three sides and the front fitted with a pair of folding doors, as shown. The illustration also shows a useful form of rack in the well of the bench, to keep a few of the tools handy, but so that their edges do not touch.

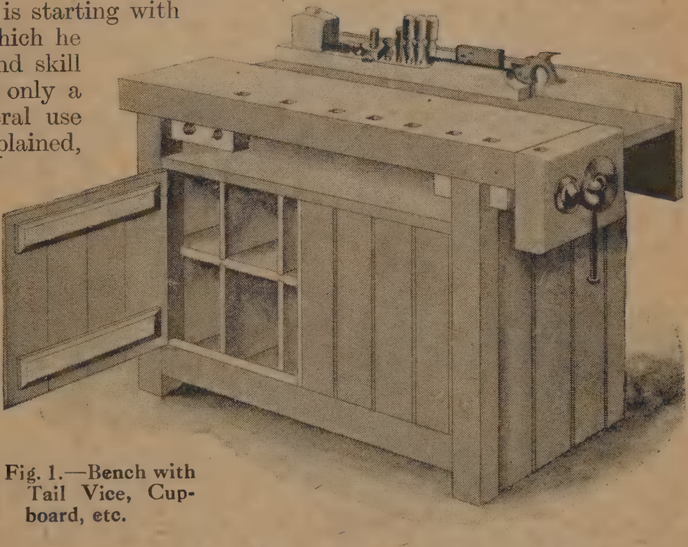


Fig. 1.—Bench with Tail Vice, Cupboard, etc.

The spring stops already referred to are of the shape shown in Fig. 2. They fit into the square holes along the front of the bench (see Fig. 1), and the spring holds them at any required height.

Another excellent portable bench is shown photographically by Fig. 3, and in a later chapter the working drawings and notes on its construction will be presented.

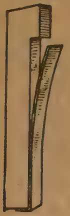


Fig. 2.—Spring Bench-stop

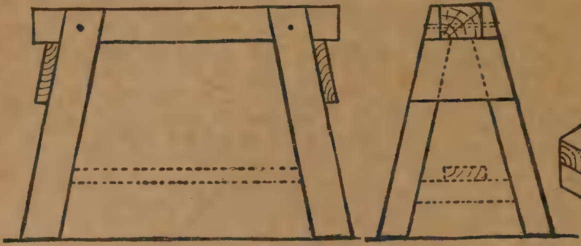


Fig. 4.—Sawing-stool

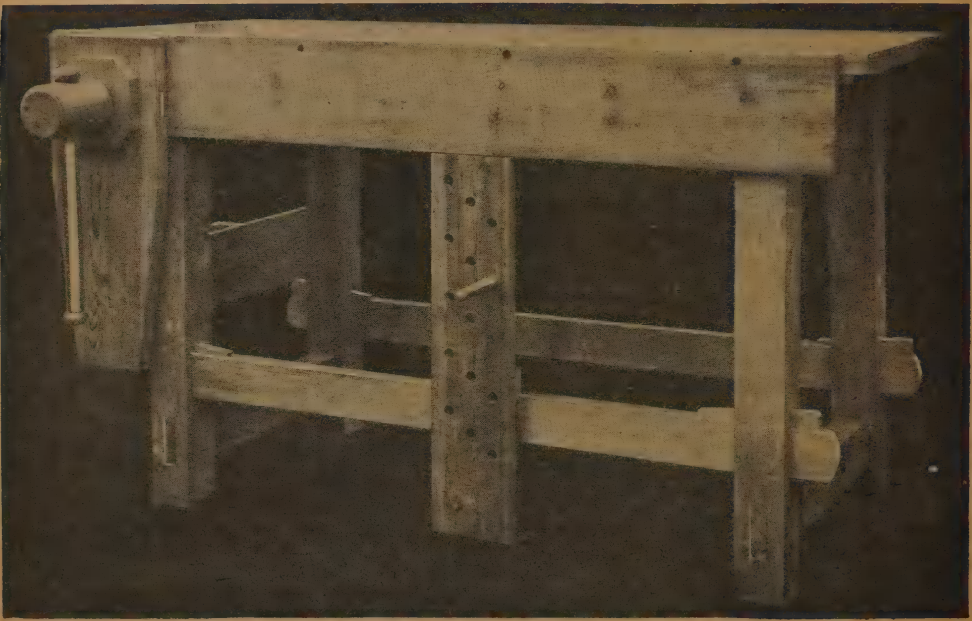


Fig. 3.—A Portable Bench of Simple Construction

Stools.—Two stools will be found useful, and may be of the ordinary pattern, as in Fig. 4; but it might be more serviceable to have one with a broader top, as it will be found very convenient for mortising and doing other similar heavy work.

Bench Hook.—A useful form of bench hook or sawing block is shown in Fig. 5. This is the best kind for the beginner, and is made simply by screwing together three pieces of wood as shown.

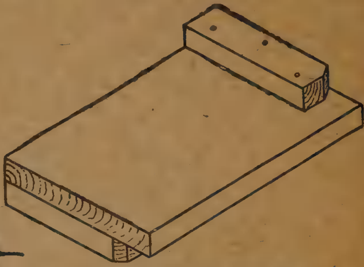


Fig. 5.—Bench Hook

Hand Tools.—The tools necessary for beginning woodwork are not many or expensive, the list at the head of page 7, although it is quite short, even including some that could be dispensed with for a time.

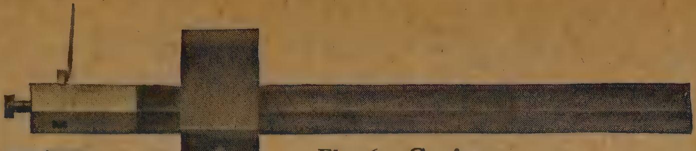


Fig. 6.—Cutting Gauge

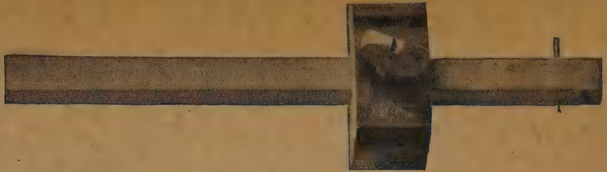


Fig. 7.—Marking Gauge

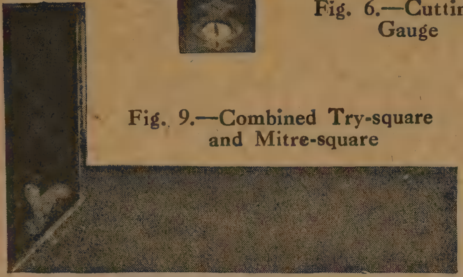


Fig. 9.—Combined Try-square and Mitre-square

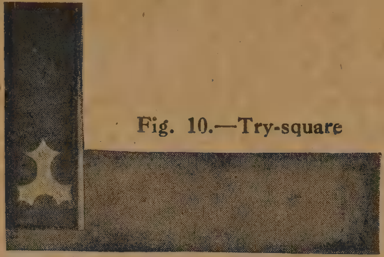


Fig. 10.—Try-square

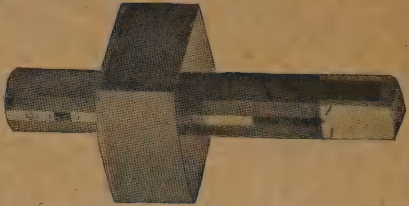


Fig. 8.—Mortise Gauge

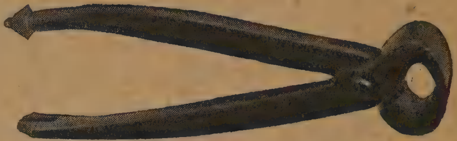


Fig. 16.—Pincers (Lancashire Pattern)

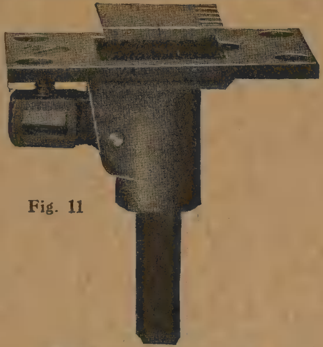


Fig. 11

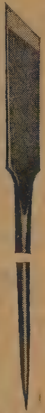
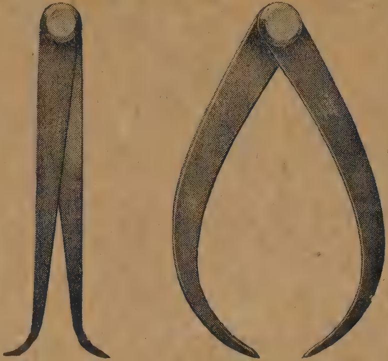


Fig. 13.—Marking Awl and Knife



Figs. 14 and 15.—Inside and Outside Callipers

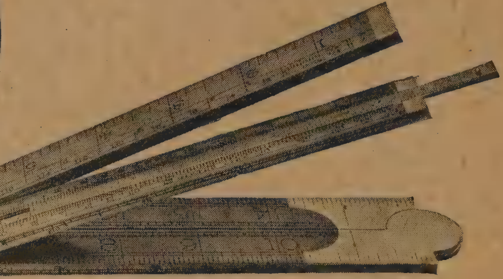


Fig. 18.—Two-foot Rule with Slide Rule

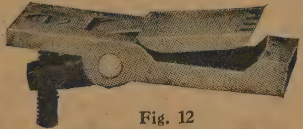


Fig. 12

Figs. 11 and 12.—Two Adjustable Bench Stops

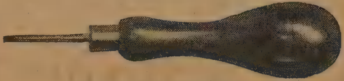


Fig. 17.—Bradawl

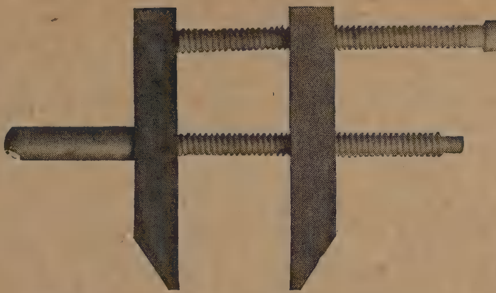


Fig. 19.—Wooden Hand-screw Cramp

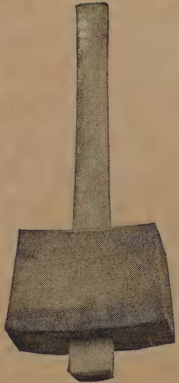


Fig. 20.—Mallet

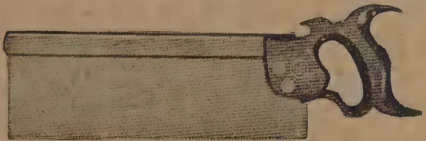


Fig. 21,—Tenon Saw

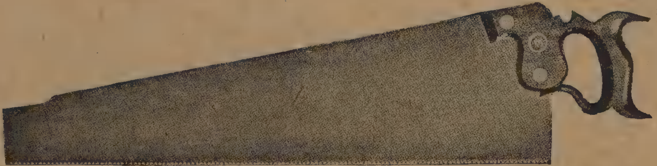


Fig. 22.—Hand Saw

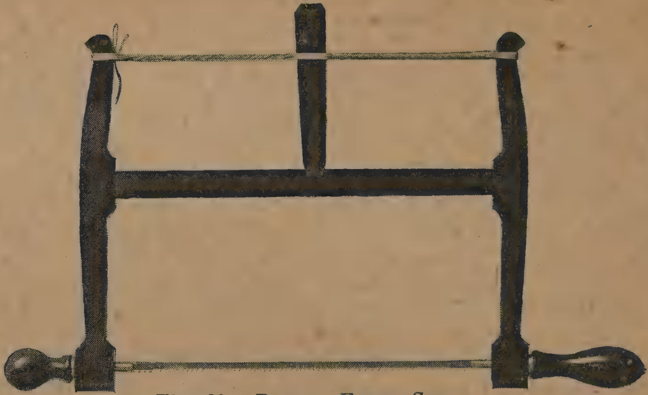


Fig. 23.—Bow or Frame Saw

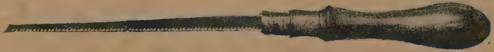


Fig. 24.—Pad Saw

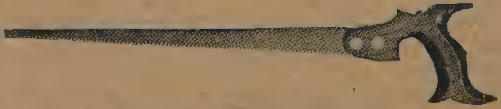


Fig. 25.—Compass Saw

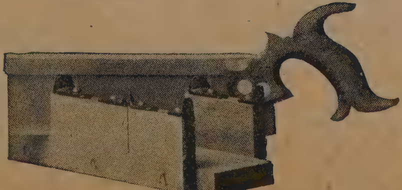


Fig. 26.—Dovetail Saw in Mitre Box

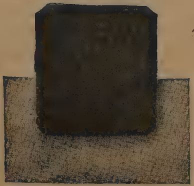


Fig. 27.—Steel Scraper

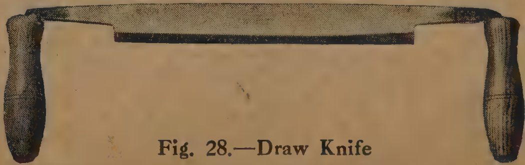


Fig. 28.—Draw Knife

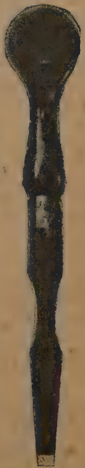


Fig. 29.—
Screwdriver
(London
Pattern)

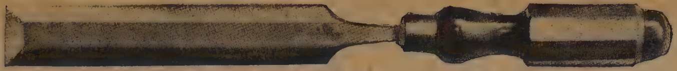


Fig. 30.—Long Paring Chisel

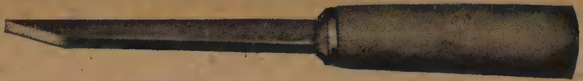


Fig. 32.—Mortise Chisel

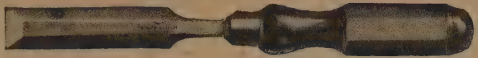


Fig. 31.—Firmer Chisel

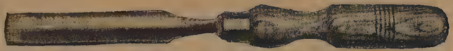


Fig. 33.—Firmer Gouge

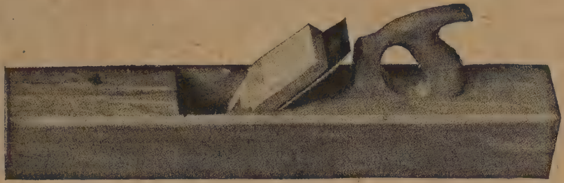


Fig. 34.—Trying Plane

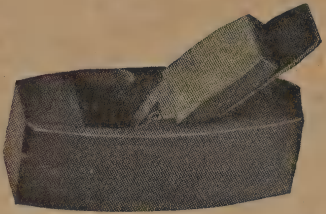
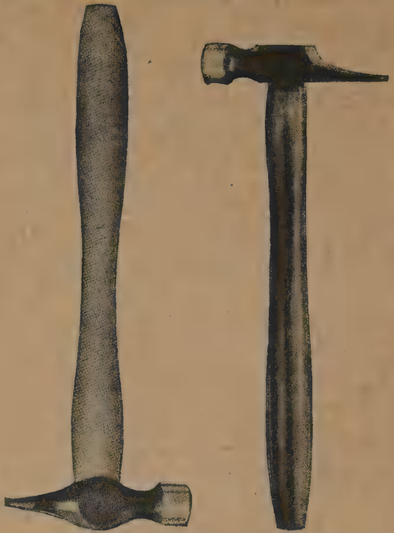


Fig. 35.—Wooden Smoothing Plane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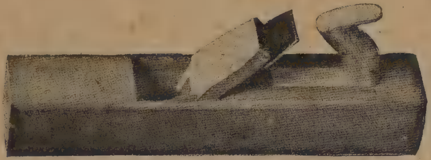
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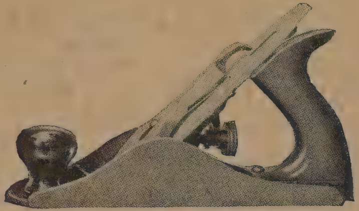


Fig. 37.—Iron Smoothing Plane

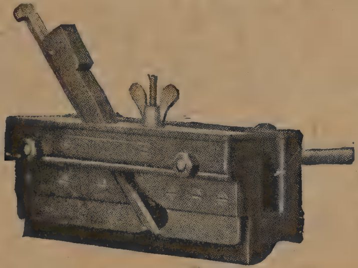


Fig. 40.—Plough

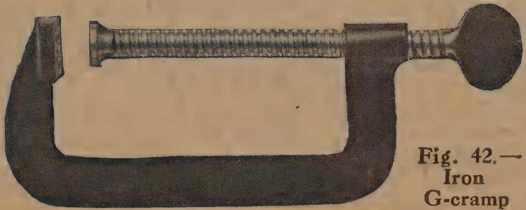


Fig. 42.—Iron G-cramp

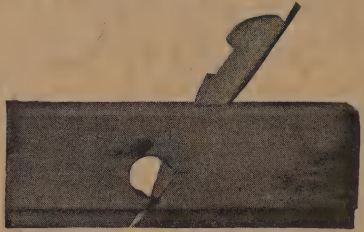


Fig. 41.—Rebate Plane

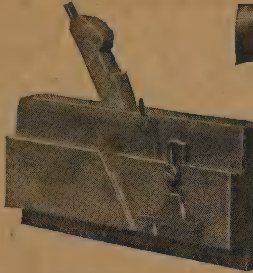


Fig. 43.—Side Fillister

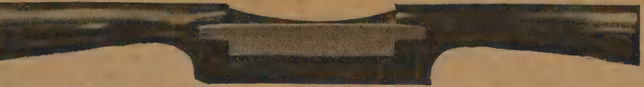


Fig. 45.—Wooden Spokeshave

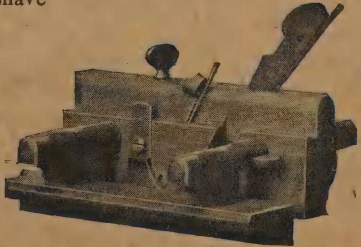


Fig. 44.—Sash Fillister

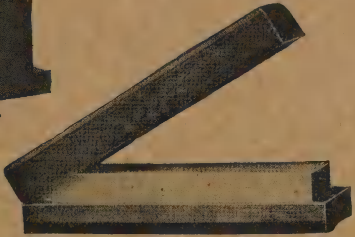


Fig. 48.—Oilstone in Case

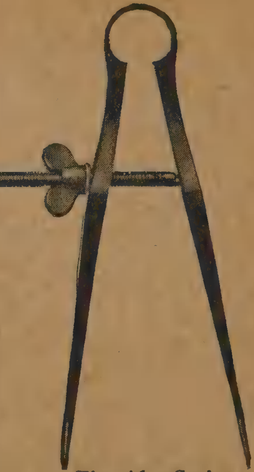


Fig. 46.—Spring Dividers

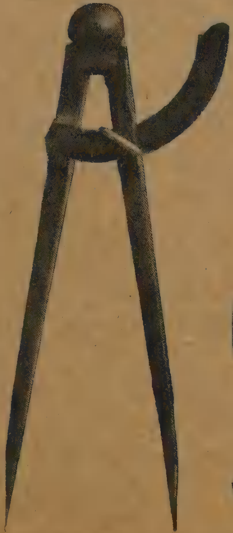


Fig. 47.—Wing Compasses

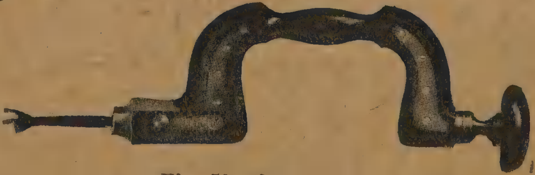


Fig. 50.—Wooden Brace

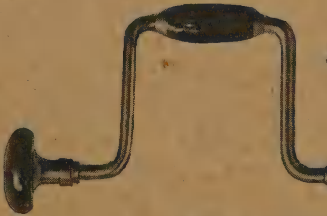


Fig. 49.—Steel Brace

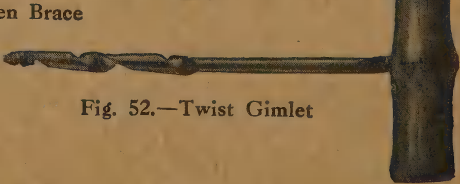


Fig. 52.—Twist Gimlet

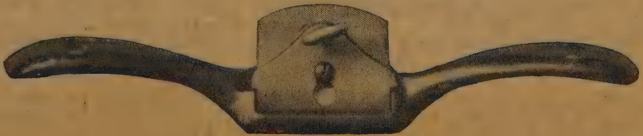


Fig. 51.—Iron Spokeshave

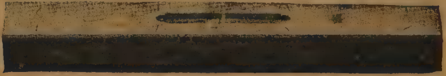


Fig. 53.—Spirit Level

Beginner's Tool-set

- 2-ft. rule, two-fold
- Setting-out knife
- Marking gauge
- Try-square, 6 in.
- Brace and Bits
- Hand saw, 22 in.
- Tenon saw, 14 in.
- Dovetail saw, 8 in.
- Jack plane, 14 in. by 2 in.
- Trying plane, 22 in. by 2¼ in.
- Smoothing plane, 2 in.
- Rebate plane, 1 in.
- Oilstone
- Hammer
- Pincers, 6 in.
- Mallet, 5 in.
- Screwdriver, 7 in.
- Bradawls, 3 sizes
- Firmer chisels, ¼, ½, ¾, 1, 1¼ in
- Sash or mortise chisel, ¼ in.
- Sash or mortise chisel, ½ in.

Most of these tools are illustrated among those shown by Figs. 6 to 53. A superior rule is illustrated, but the one mentioned in the above list is good enough for ordinary work.

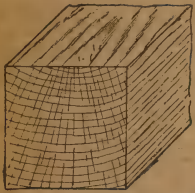


Fig. 54.—Wood Grain at End of Plane: Good

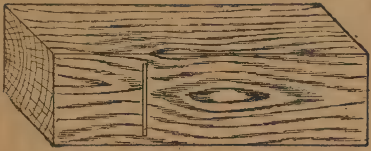


Fig. 55.—Heart Grain on Sole of Plane: Bad

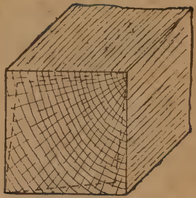


Fig. 56.—Wood Grain at End of Plane: Bad

Saw blades should be of a bright, even colour, without patches, and quite free from little dark specks or other flaws. The hand-saw type of blade is made tapering in breadth, and it should also be tapering from the teeth to the back edge. The handles of saws should be carefully fitted and firmly fastened with screw rivets to the blades. The handle should comfortably fit the hand.

The stocks of wooden planes should be prepared from beech which has been split from the log, and properly steamed and seasoned. The object of these processes is to prevent warping and twisting, so that the plane may remain true. The long grain should be as straight as possible, the end of the plane showing the annual layers running nearly parallel with the face, and the medullary rays perpendicular to it, also the layers nearest the heart at the top surface of the plane. These features are indicated in Fig. 54 on this page.

A plane with a sole (or face) having heart grain, as shown in Fig. 55, should be avoided, as it indicates that the stock has been cut from a log of crooked growth, this causing the face to wear unevenly, and rendering the stock liable to warp. Plane stocks that have been cut from the log, so that the grain on the end appears as shown in Fig. 56, become untrue on being acted on by the atmosphere, and thus contract and expand in the manner indicated by the dotted lines.

All bright-steel parts of chisels should be of an even colour, free from specks or spots, small holes, or flaws. On sharpening plane irons and chisels very little "wire edge" should appear; but if none at all is seen, possibly the edges may be too hard. Thus the hardening and tempering process may have been improperly carried out.

Tool handles are made of various hard woods, but beech or ash is very serviceable for the first few chisels required by a beginner. They are nice woods to use, and will stand occasional light blows with the mallet.

The Washita (properly, Ouachita) is a quick-cutting oilstone that produces an edge sufficiently fine for wood-working tools. The oilstone should be bought already cased, unless the reader has acquired sufficient knowledge of wood-working to case the stone himself. Care should be taken to select stones that do not show vein marks, although these are sometimes so very fine that their presence is not detected without very close scrutiny.

Care of Tools.—The keeping of tools in a bass or basket, although this method

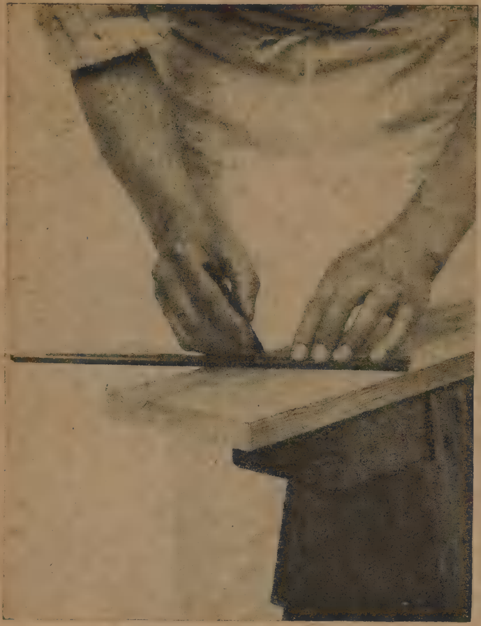


Fig. 57.—Dividing Board into Equal Parts with Rule

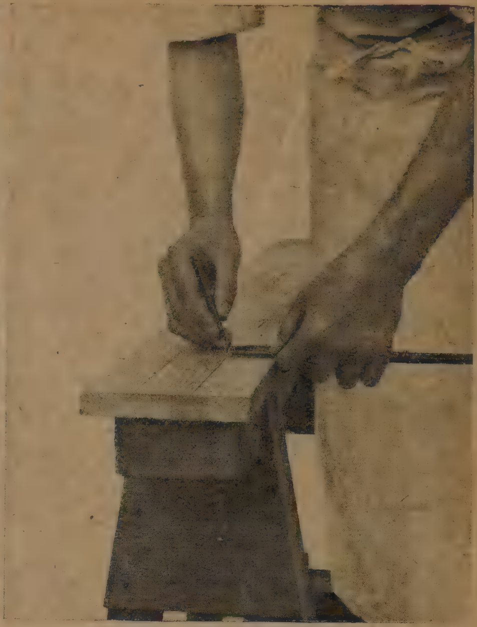


Fig. 58.—Using Forefinger, Rule, and Pencil for Lining Down Board

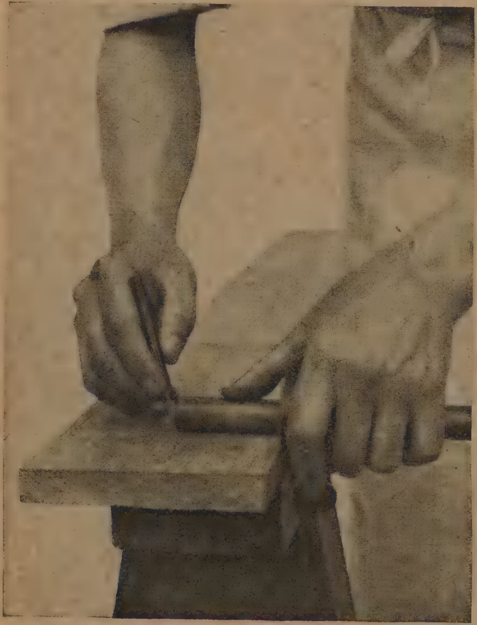


Fig. 59.—Using Marking Gauge for Lining Down Board

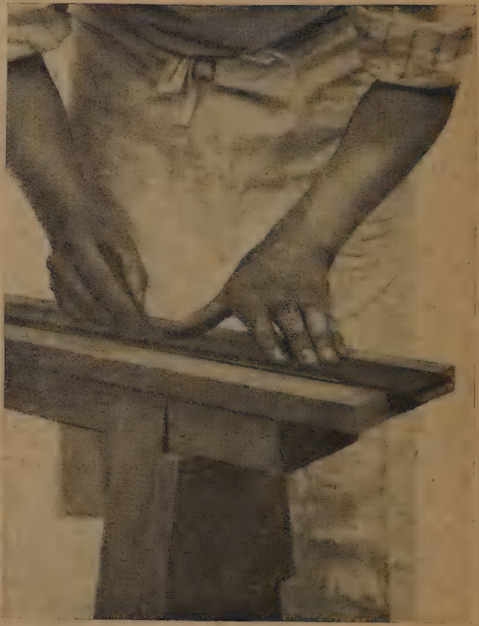


Fig. 60.—Lining Down with Pencil and Straightedge

is the only one possible to many workmen, should never be adopted by the amateur mechanic, as it leads to the blunting of the tool edges. It is better to hang up saws and arrange chisels and other tools in racks, because they are thus more readily accessible. All tools should be sufficiently cleaned to maintain them in good order and appearance. This may be done by occasionally damping a piece of cotton waste or rag with oil (not linseed) or a little vaseline, and rubbing the steel parts. Of course, care should be taken to prevent the destruction of the tools by rust. The wooden parts of tools should be occasionally rubbed with cotton waste or rag moistened with linseed oil, taking care not to leave any superfluous oil on the surfaces, as it is liable to become sticky. In the case of new planes it is a good plan to soak them well with linseed oil a short time before using, and then, by well rubbing the surfaces, a dull finish is obtained, and by following this by an occasional rub, the surfaces are kept clean and in good condition.

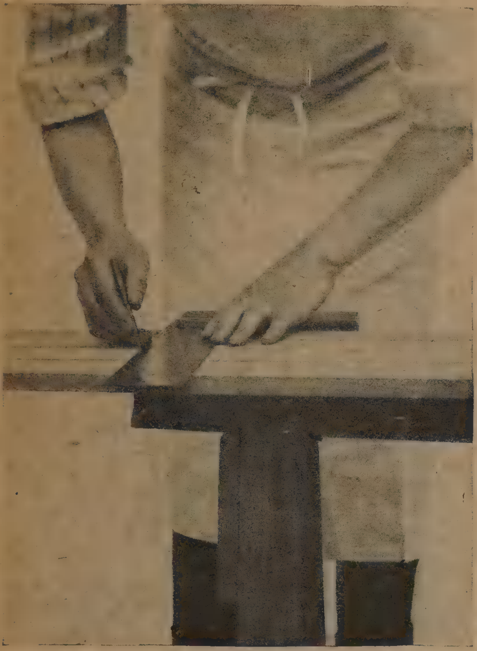


Fig. 61.—Lining Out Across Board with a Try-square

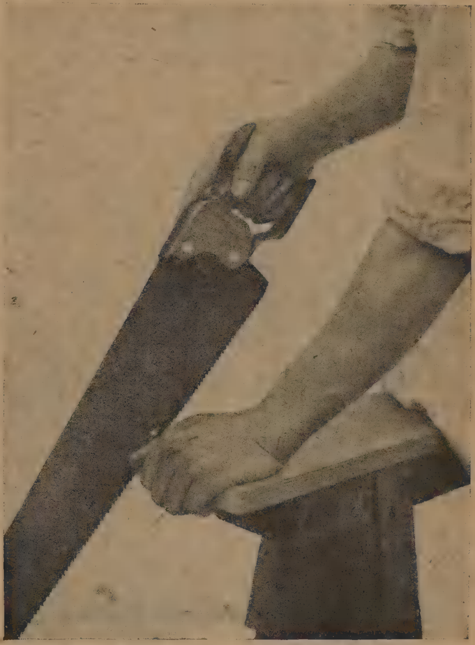


Fig. 62.—Guiding the Saw with Thumb at the Start

In the case of the oilstone, the cover should always be kept on when the oilstone is not in use. Any thickened oil should be rubbed off, and not allowed to form a corrosion with dirt round the edges of the case. Plane irons should not be allowed to become "thick" at the edges, but kept thin by grinding. The sharpening of saws should be done by professional saw-sharpeners until the worker is sufficiently experienced to do this himself, instructions in which work will be given later.

LINING OUT MATERIAL

Sometimes it is desirable to cut a board into several strips of equal breadth. For example, Fig. 57 shows a board $6\frac{1}{2}$ in. wide, which is to be divided into three. Thus placing the rule as shown with its end against one edge of the board, and so that the division 9 is over the other edge, then marks can be readily made at 3 and 6.

Fig. 58 shows a ready method of lining a board for sawing where only approximate accuracy is required. The rule is held with the left hand, the forefinger being kept against the edge of the board and the rule, so that the particular division of the latter is just over the edge of the board. Then, with the right hand holding the pencil point against the end of the rule and on the board, the hands and pencil are moved from the end along the board, the line being thus produced; some amount of practice is required before proficiency is gained in this method.

The use of the marking gauge, although not so speedy as the previous method, is more accurate and easier for a beginner, and is therefore recommended for the present. The gauge is set by measuring the desired distance from the back end of the shaft to the stock, then the pencil is held against the end of the shaft whilst the left hand keeps the stock close to the board (*see* Fig. 59), and thus by the backward movement the mark is made.

Sometimes it is more convenient to mark off the breadth near each end of the piece required. Then, placing a straightedge to these marks, the line can be made as indicated in Fig. 60. Then the lengths of the pieces are marked out by means of a try-square and pencil as shown in Fig. 61.

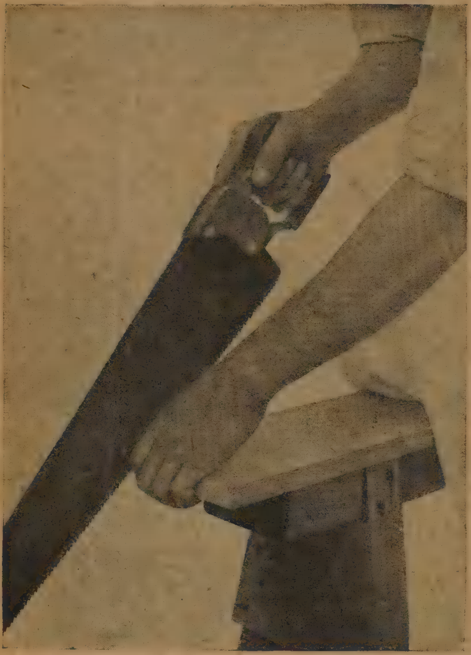


Fig. 63.—Guiding the Saw with Forefinger and Knuckle at the Start

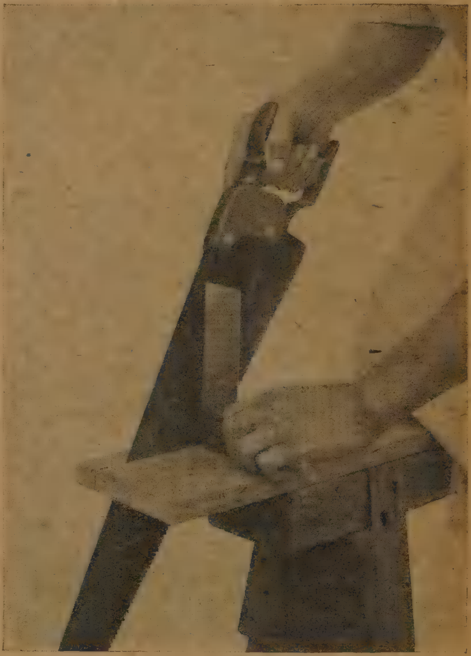


Fig. 64.—Testing Saw for Squareness with Surface of Board

SAWING

Ripping or Sawing with the Grain.—The beginning of a saw kerf or cut deserves special attention, because, if not properly done, the whole of the kerf will probably be faulty. The saw handle should be held as clearly shown in Figs. 62 to 66. The left hand should rest on the work to assist in steadying the body, and at the same time to guide the blade of the saw to the line. This may be done by means of the thumb, as shown in Fig. 62, or by the forefinger and knuckle, as shown in Fig. 63.

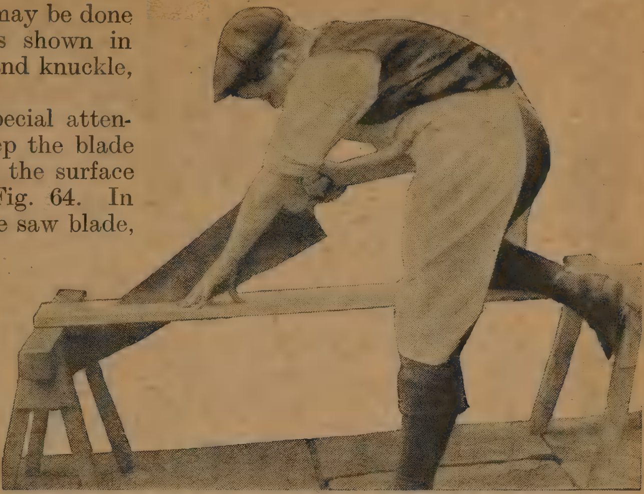


Fig. 67.—Side View, Showing Saw Held too Sloping

Another point deserving special attention is to begin with and keep the blade of the saw at right angles to the surface of the wood, as shown in Fig. 64. In sawing a horizontal board, the saw blade, centre of the wrist, elbow, shoulder, and vision should as near as possible be all in one vertical plane, as shown in Fig. 65, where it should be noticed that the body is so posed that there is full freedom for the elbow to work without touching the side. The body is properly balanced; as the piece of material is being sawn, it is necessary to place the right knee on it; this, together with the left arm, should give an easy pose and balance of the body, and at the same time full freedom for the movement of the right arm. Fig. 66 shows the angle of the saw with the wood (50° to 60°).

A common and faulty method of holding the saw is shown in Fig. 67, where it will be seen that the saw is held at too small an angle, thus causing a waste of energy and time, as the wood cannot be cut nearly so fast or so easily. Two other common faults are shown in Figs. 68 and 69. In the first case, the worker is shown with his head inclined too much to the left, this causing the saw to be inclined in that direction. In Fig. 69 the head is

Fig. 65

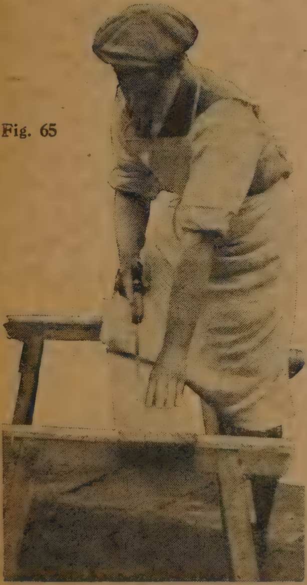
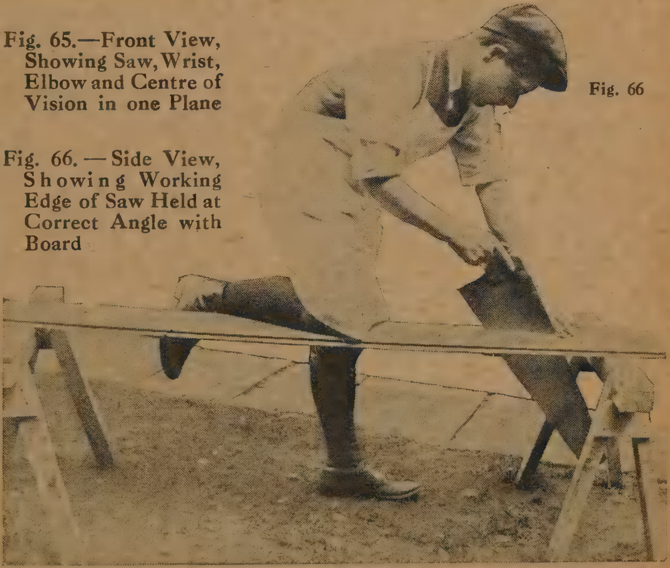


Fig. 65.—Front View, Showing Saw, Wrist, Elbow and Centre of Vision in one Plane

Fig. 66.—Side View, Showing Working Edge of Saw Held at Correct Angle with Board

Fig. 66



inclined too much to the right. These three illustrations indicate the principal causes of wood being sawn out of the square. Regular strokes should be made with the saw, making them nearly its length, so as to use as many of the teeth as possible. Quick, short, jerky strokes invariably lead to bad sawing. The saw should be used as lightly as possible; that is, great pressure should be avoided, as it generally results in the saw running from the line. To correct this, beginners frequently bend and twist the blade, by which means it is quickly buckled and damaged.

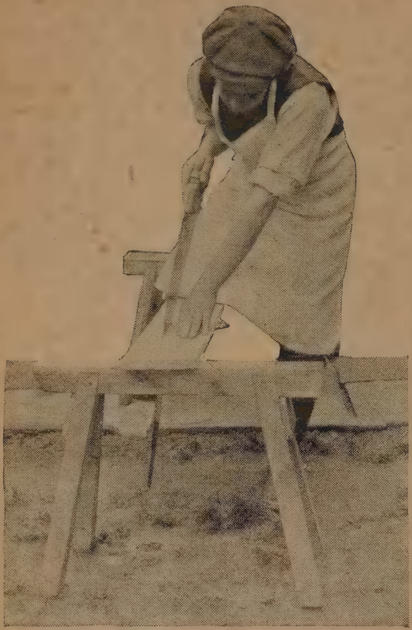


Fig. 68.—Front View, Showing Head and Saw Inclined Too Much to the Left

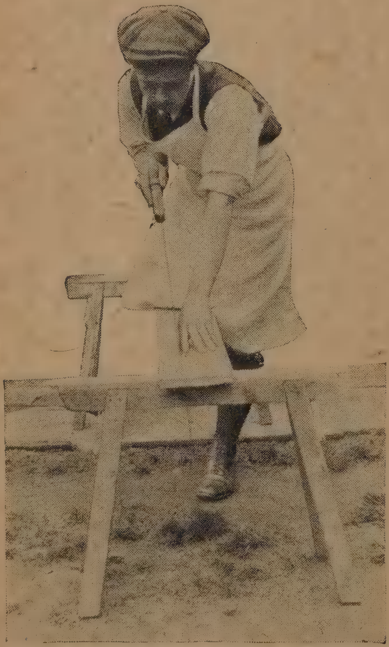


Fig. 69.—Front View, Showing Head and Saw Inclined Too Much to the Right

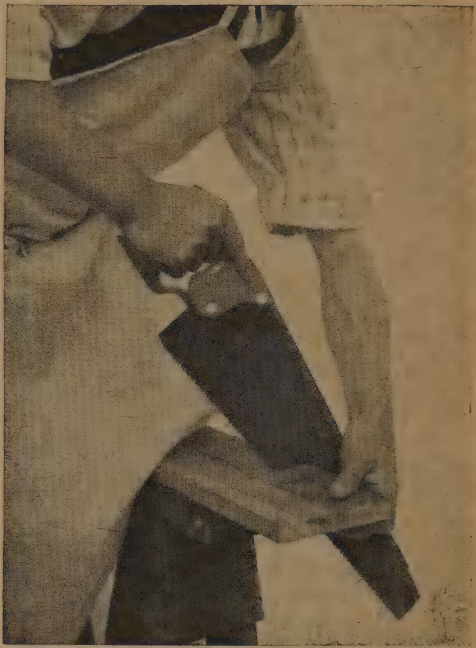


Fig. 70.—Holding Overhanging Piece in Cross-cut Sawing

Cross Cutting.—In starting the kerf across the grain, the hands and fingers are held in the same positions as indicated in Fig. 62 for sawing with the grain. In sawing off small pieces which are unsupported, it is a good method, when within an inch or two of the completion of the saw cut, to hold the board with the knee and the piece with the left hand, as shown in Fig. 70, to prevent sudden breakage and splintering.

Marking off Distances.—It is almost needless to say that the setting out of work is of the greatest importance, inasmuch as any inaccuracy in marking off distances and squaring over will affect the finished work even if the sawing and other operations are very carefully carried out by working to the lines.

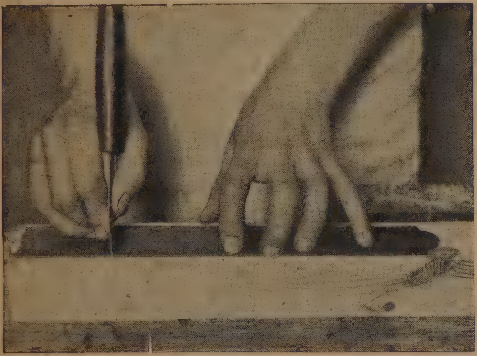


Fig. 71.—Marking off with Knife

Usually, in a simple case, the best plan is to start by placing the face side of the work uppermost, and the end of the rule flush with one end of the work, and then to mark off the distances required by means of a marking awl or the sharp end of a scriber. Care should be taken to hold the tool as vertically as possible, and opposite the particular division on the rule, and at the same time to look vertically down and not obliquely, as is frequently done by beginners, the incorrect method leading to inaccuracy because it is impossible properly to see when the tool is opposite the division of the rule. Fig. 71 shows the right method.

Preparing to Scribe across the Face Side.—The method of holding the try-square is shown in Fig. 72, in which it will be seen that the face of the stock of the try-square is kept against the face edge of the work by the left hand; this should be done by means of the thumb and the third and fourth fingers, as shown, whilst the first and second fingers press the blade closely to the face side of the work. At the same time the point of the scriber should be placed in the mark as indicated.

Scribing across the Face Side.—Next, the try-square should be pushed up to the scriber as shown, taking care to press the stock and work closely together. Next make the cut with one or more strokes of the scriber according to the depth of the cut line required. This operation is illustrated at Fig. 73.

Preparing to Scribe across the Face Edge.—The work is turned over, and the scriber placed in the end of the cut made on the face, and the try-square held so that the stock is against the face of the work as shown at Fig. 74.

Scribing across the Face Edge.—After having completed the above preparations, the square is pushed forward so that the blade touches the scriber as at Fig. 75, and then the cut line is made. It is essential to remember that, whenever possible, the stock of the square should always be pressed against the face edge or the face side of the work, as the case may be, because they are necessarily the true faces of the work and it frequently happens that the third and fourth are out of truth. The face mark is clearly shown in Figs. 74 and 75.

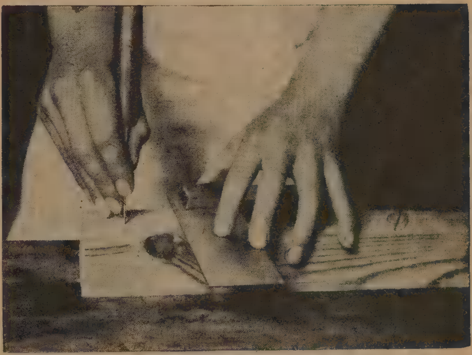


Fig. 72.—Preparing for Scribing

SAWING WITH THE GRAIN WITH THE TENON SAW

The general position for this work is shown at Fig. 76. It is important that the lines, saw blade, wrist, and elbow should be as nearly as possible in one plane. In order to give freedom for the movement of the elbow of the left arm it should be a little in advance of the right. In starting the kerf, the saw should be tilted as shown in Fig. 77. The left thumb is placed on the work and against the saw blade so as to regulate the saw in such a manner that the teeth are quite in the waste but just against the line. The kerf is then started by a slight backward stroke. With a few careful strokes, the saw is gradually brought into a horizontal position and the kerf made right across the work, as indicated in Fig. 78. The sawing is then continued by gradually lowering the handle end, as shown at Fig. 79, the object being to follow the line and make the cut on the side which is in the direct view of the operator. The work should be turned completely round two or three times and sawn in the way just described. The kerf is finished by a few level strokes of the saw, as in Fig. 80.

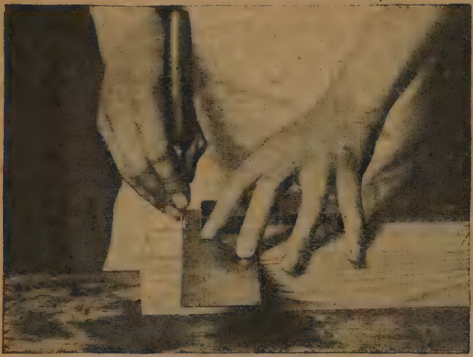


Fig. 73.—Scribing Across Face Side

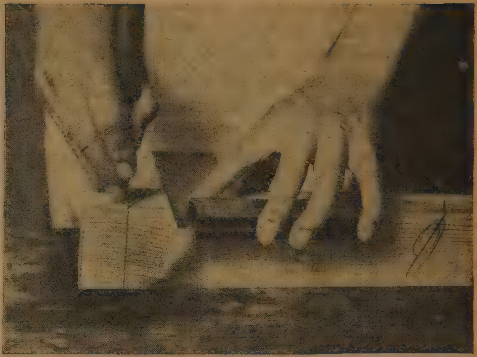


Fig. 74.—Preparing to Scribe Across Face Edge

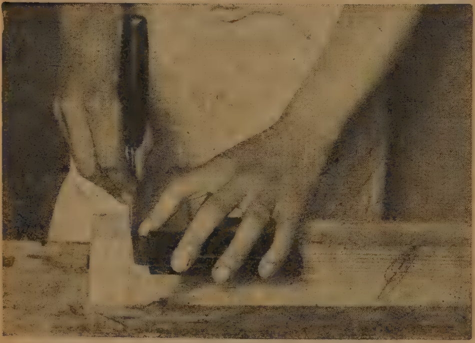


Fig. 75.—Scribing Across Face Edge

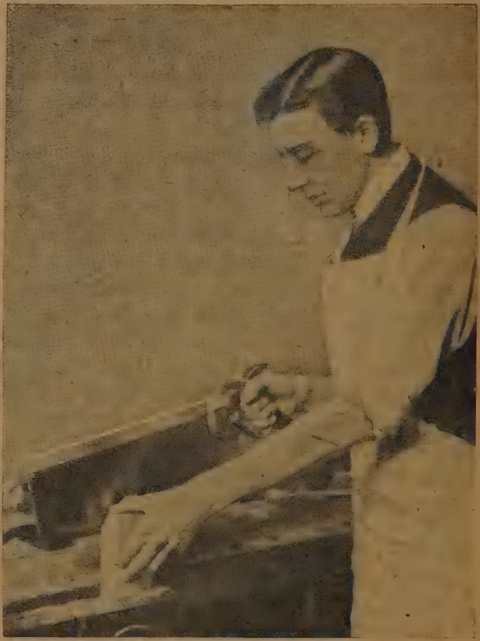


Fig. 76.—Sawing with the Grain

Good and Bad Saw Kerfs.—At Fig. 81 are shown three saw kerfs. That at

A has been made wholly on the wrong side of the line; that at B demonstrates a rather common mistake of sawing on the line, by which half the thickness of the saw (measured across the teeth) has been taken out on each side of the line; and that at C shows, of course, the correctly made kerf, just the thickness of the saw being taken wholly out of the waste.

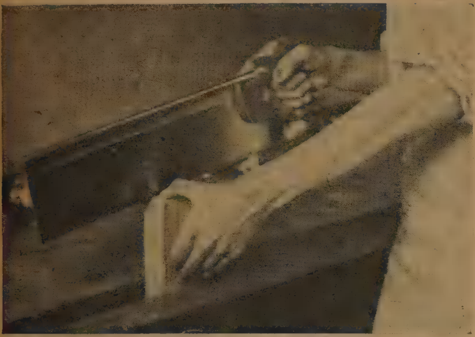


Fig. 77.—Starting the Kerf

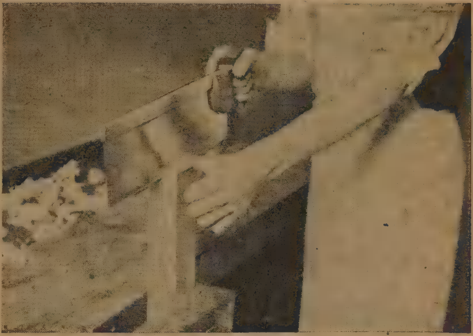


Fig. 78.—The Kerf Well Started

Alternative Method of Starting a Saw Kerf.—The method shown at Fig. 82 for starting the kerf is in favour with some workers, but the author's many years' experience as craftsman and teacher causes him without hesitation to recommend that the kerf be started at the far end of the line, as previously described. The beginner is more likely to cut true by the method shown in Fig. 77.

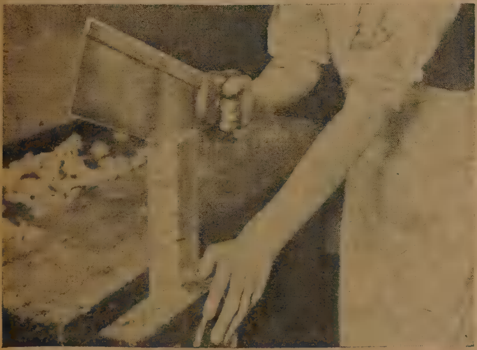


Fig. 79.—Following Line on Side Facing Operator

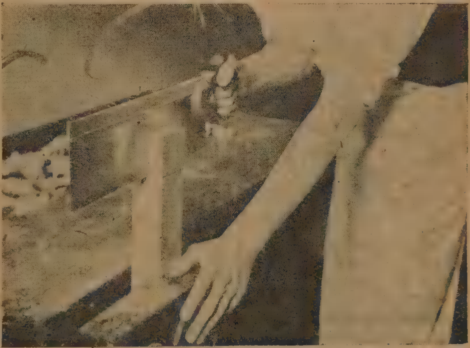


Fig. 80.—Finishing the Kerf

SAWING ACROSS THE GRAIN WITH THE TENON SAW

The general position for this operation is given at Fig. 83. The remarks as to line, saw, centre of arm line, vision, etc., given for sawing with the grain, apply equally here. The method of starting the kerf on narrow pieces, which can be grasped together with the stock of the bench hook, is illustrated at Fig. 84. The forefinger of the left hand is placed so as to adjust the blade and teeth exactly in their proper relation to the line. The kerf is started by a slight backward stroke at the far arris of the wood by holding the handle end of the saw higher than the other end, as shown. The saw is then gently pushed forward, and then to and fro, extending the kerf right across the face of the work by gradually bringing the teeth into a horizontal position, as in Fig. 85, where it will be seen that the forefinger has been removed from the side of the blade and is used to assist in holding the work. Fig. 86 shows three kinds of sawing across the grain with regard to the lines. Let it be assumed that the three parts A, B, and C are to be removed and leave spaces exactly the same size. By sawing on the line it will be seen that A will be too wide by half the thickness of the kerf on each side; that B will be too wide by twice the thickness of the kerf; whereas C will be the proper size, because the kerfs will be in the waste material on each side, leaving the sharp arris of the cut line intact.

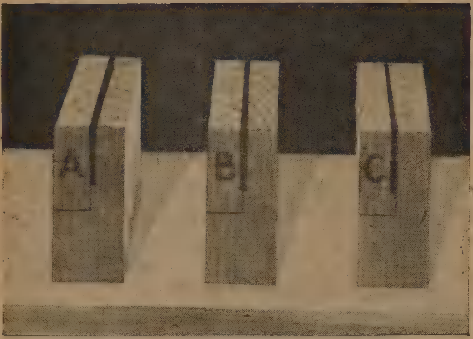


Fig. 81.—Good and Bad Saw Kerfs

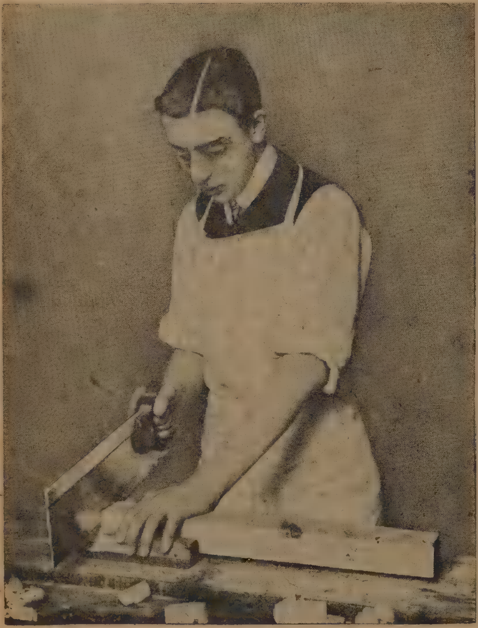


Fig. 83.—Sawing Across the Grain

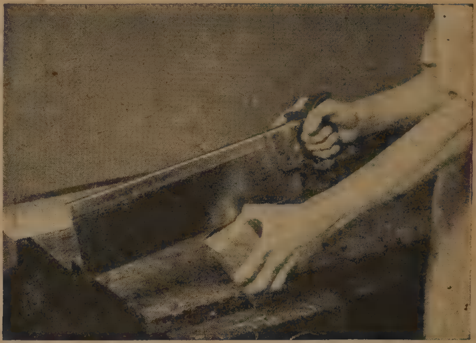


Fig. 82.—Another Method of Starting Kerf

Sawing Wide Stuff.—When sawing wide stuff across the grain with the tenon saw, it is usually more convenient to guide the saw with the left thumb when starting the kerf, this allowing of the work being held firmly against the bench hook, as indicated by Fig. 87. The kerf is made right across the face of the work by gradually bringing the saw into a horizontal position, and the work can then be better held with the left hand by placing it as shown in Fig. 88, whilst

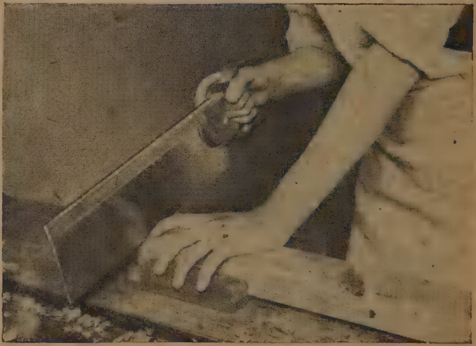


Fig. 84.—Starting the Kerf

the saw is worked with full strokes across the wood.

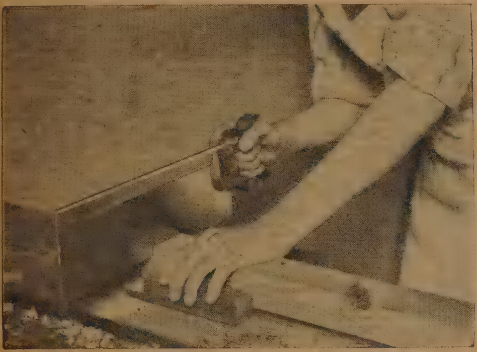


Fig. 85.—The Kerf Well Started

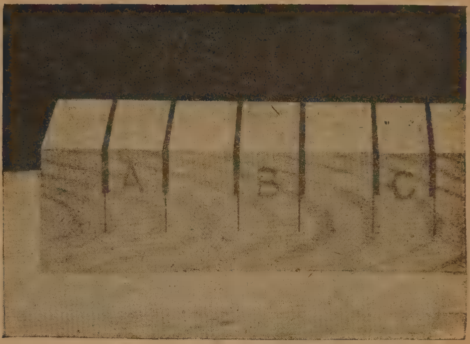
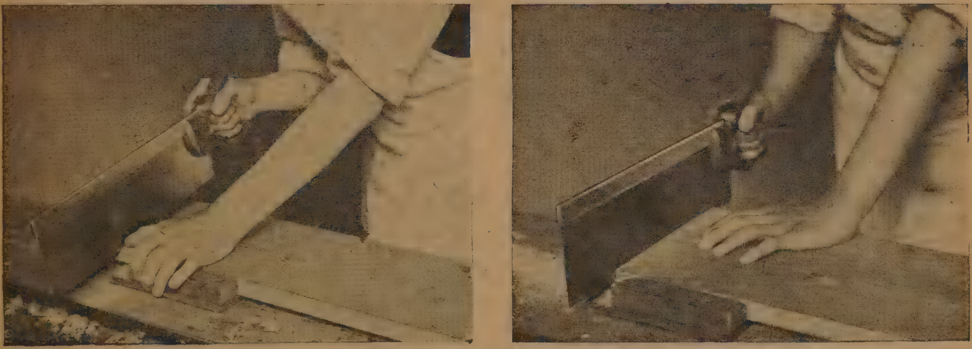


Fig. 86.—Good and Bad Saw Kerfs



Figs. 87 and 88.—Sawing Wide Stuff Across the Grain

SHARPENING AND ADJUSTING PLANE IRONS

After sawing out the material the next process is usually to plane it, which is generally designated "planing up" or "squaring up." This is probably the most important and difficult operation in wood-working, and depends to a great extent on the operator's skill in sharpening and setting the plane irons; and unless this can be performed properly, accurate and smooth work cannot be produced.

Releasing the Irons from the Stock.—There are two methods in general use for doing this. The back of the stock is held in the left hand, whilst the right hand grasps the wedge and irons, and then holding them in position as shown in Fig. 89, where it will be seen that the top of the stock is raised about 9 in. to 1 ft. above the bench. Then, with a downward spring, about 2 in. or 3 in. of the stock is made to strike the bench top (or a hardwood block), and if done smartly the wedge and irons are released from the stock as shown in Fig. 90. The method which is perhaps most common is shown in Fig. 91. The stock is grasped with the left hand, the fingers reaching to the face of the plane and the left thumb in the throat, and the end of it pressing on the iron. Then, with two or three smart, square blows with the hammer, a movement of the irons will be felt by the left thumb, which will indicate that they and the wedge are released. The operator can thus judge when to discontinue striking. The irons and wedge should then be taken out of the throat.

Separating the Irons.—A good method of loosening the screw is shown in Fig. 92. It should be remembered that the screw seldom requires more than a complete turn. Laying down the screwdriver, the edges of the cutting iron should be held between the fingers and thumb of the right hand, and the edges of the back iron between those of the left hand. The irons are then carefully slipped apart as shown in Fig. 93.

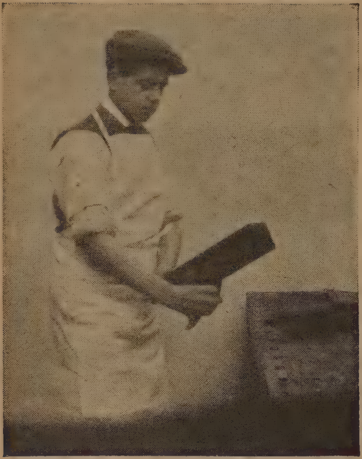


Fig. 89.—Releasing Plane Irons by Striking on Bench

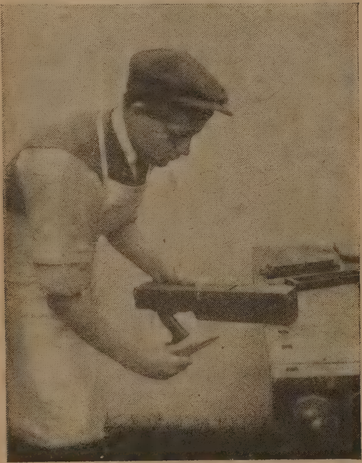


Fig. 90.—Taking Released Irons from Stock after Striking on Bench

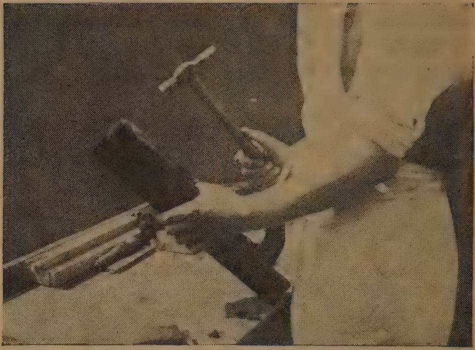


Fig. 91.—Releasing Irons by Striking with Hammer

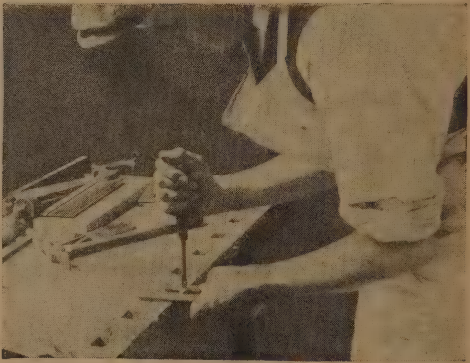


Fig. 92.—Method of Holding Irons while Unscrewing

Sharpening the Cutting Iron.—Hold the cutting iron in the right hand as shown in Fig. 94. Then, placing the bevel on the oilstone, adjust the left hand to the iron, so that three fingers rest on its face and the thumb is extended under it. Then the sharpening should be done with careful strokes extending nearly the length of the oilstone, and holding the iron at one constant angle with its surface (see Fig. 95). Use an equal pressure throughout. The angle should be about 30°. Holding the iron at one angle is generally difficult for beginners, and they most frequently impart to it a rocking

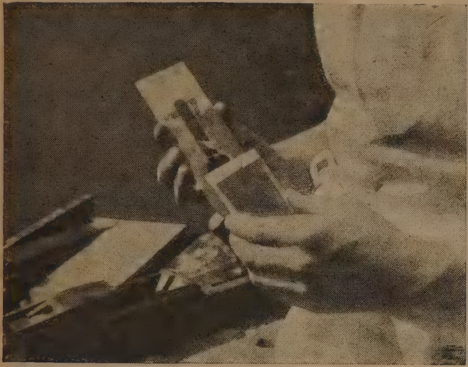


Fig. 93.—Separating Plane Irons

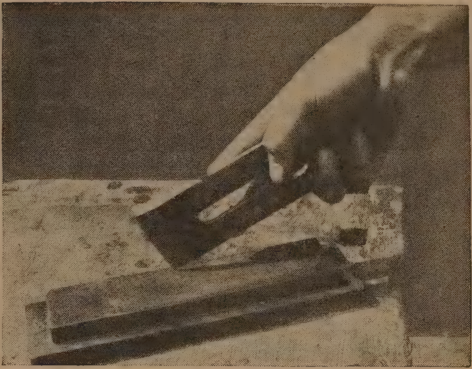


Fig. 94.—Holding Iron in Palm of Right Hand

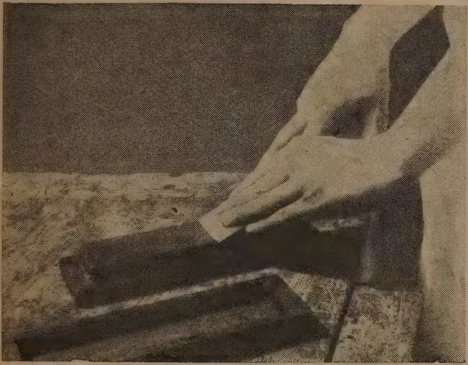


Fig. 95.—Holding Iron at the Proper Pitch

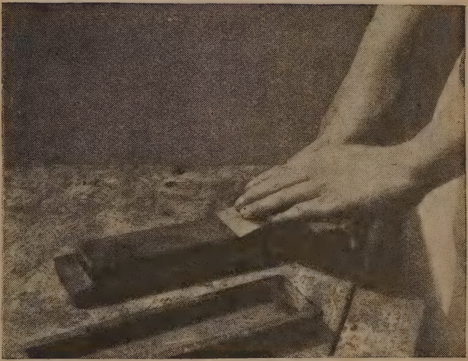


Fig. 96.—Pitch of Iron Too Low

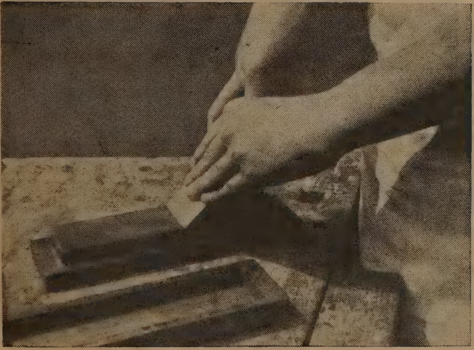


Fig. 97.—Pitch of Iron Too High

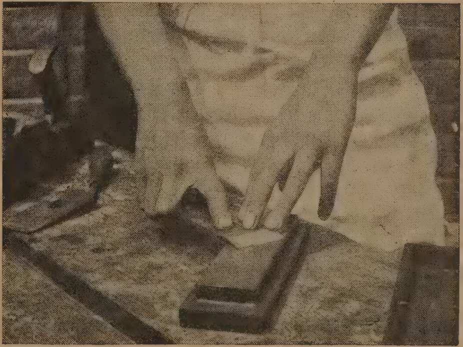


Fig. 98.—Removing Wire Edge

motion, which forms a rounded surface instead of a flat facet, or sharpening bevel, as it is sometimes known. This rocking motion may be quickly avoided by the worker not swaying his body, and only letting the main movements proceed from the elbows and shoulders. Particular attention should be paid to obtain the correct angle, and overcome the common faults of holding the irons too flat, as shown in Fig. 96, or at too great a pitch, as shown in Fig. 97. During the backward and forward strokes there should also be slight side movements, so that the whole edge is sharpened, and at the same time caused to be a little rounded.

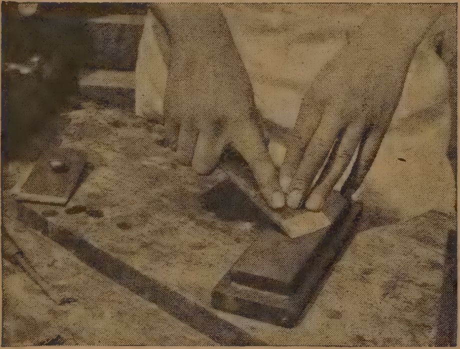


Fig. 99.—Tilting the Iron when Removing Wire Edge

Removing the Wire Edge.—The iron should next be turned over, and held with its face pressed quite flat to the face of the stone, as shown at Fig. 98, and then moved to and fro once or twice, so as to remove what is known as the "wire edge." Most beginners are liable to raise the left hand a little (even when they try not to), and thus tilt the iron so that the edge just touches the stone as shown in Fig. 99, thus forming a bevel on the face of the iron and reducing its cutting efficiency. Therefore every effort should be made to overcome this difficulty. The oil should now be wiped off with some clean shavings, and the edge examined to see if it is sharp. The iron is held so that the light falls on the edge; then, if it is not sharp, it will appear as a white line.

Adjusting the Cutting Iron and Back Iron.—Taking the cutting iron in the right hand and the back iron in the left hand as shown in Fig. 100, carefully slide them together, and adjust their edges as in Fig. 101, so that the edge of the back iron is $\frac{3}{32}$ in. from the edge of the cutting iron. (This distance varies with the kind of work, plane, etc., and further particulars will be given later.) Carefully hold both irons between the thumb and fingers of the left hand, and tighten up the set-screws with the right hand. Then tighten up as in Fig. 102.

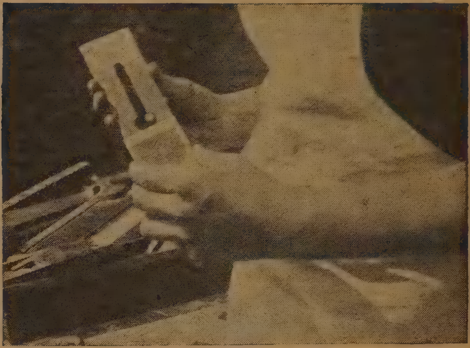


Fig. 100.—Sliding Irons together

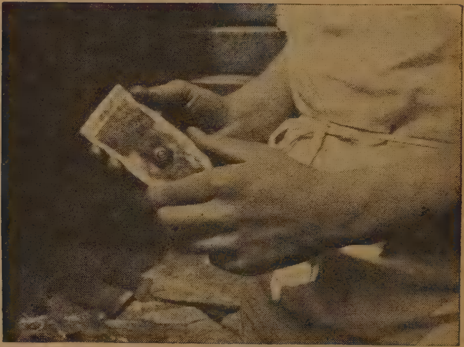


Fig. 101.—Adjusting Edges of Irons

Setting Irons in the Stock.—Set the irons in the stock as shown in Fig. 103, where it will be seen that the stock is held by the left hand, the four fingers being on the face of the plane, whilst the thumb is far into the throat, at the same time pressing and holding the irons, the

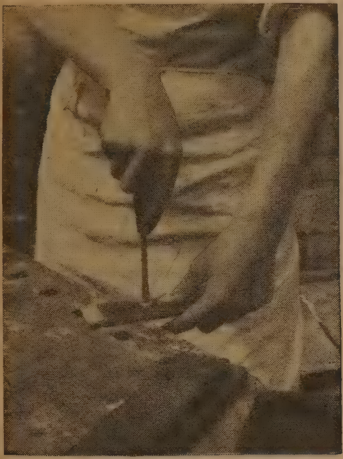


Fig. 102.—Fastening Set-screw

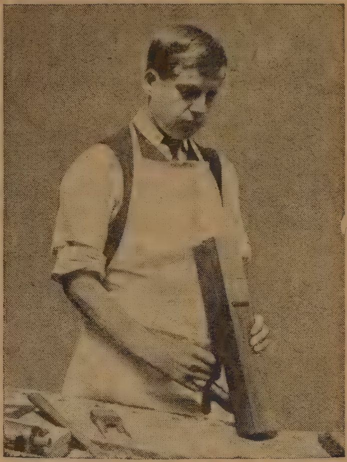


Fig. 103.—Adjusting Irons in Stock

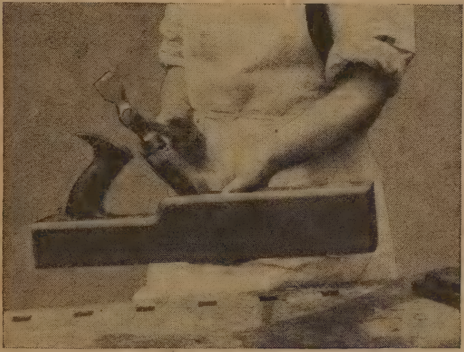


Fig. 106.—Tightening Wedge in Plane

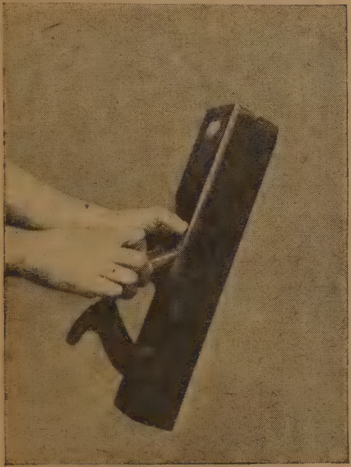


Fig. 104.—Inserting Wedge

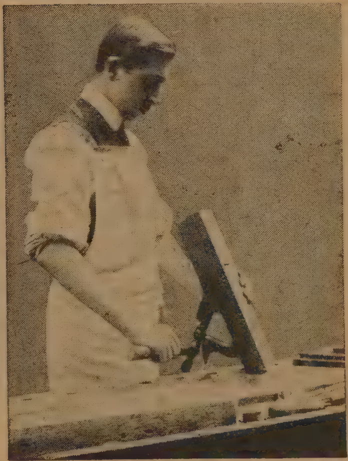


Fig. 105.—Tapping Iron for Projection

irons being regulated by the right hand, so that the cutting edge projects evenly. When this is satisfactory, the irons are held firmly in position with the left thumb. The right hand can now be used for picking up the wedge, and simultaneously the plane is rotated forwards with the left hand, and the wedge pushed firmly into position as shown in Fig. 104. The plane may now be rotated back, so that the worker can look down the face to see if any further slight adjustment is necessary, as indicated in Fig. 105. Continue to hold the plane with the left hand, then, principally by a wrist movement, it should be rotated in two directions, each about 90°, and brought to the horizontal position shown in Fig. 106. Now with the hammer in the right hand, and placing its striking face on the wedge, so that the striking may be more accurately done, give a couple of smart but moderate blows, and this will be sufficient to hold the wedge and irons firm in the stock.

Further Adjustments.—The worker should again look down the face of the stock, and if there is too much iron projecting, this can be made to recede by tapping the stock on the toe, holding the plane as was shown in Fig. 91 (p. 18). This process may somewhat loosen the wedge, therefore it should also receive a tap. Should there be not sufficient iron projecting, this may be corrected by holding the plane as shown in Fig. 106, and tapping the iron; but perhaps it will be better to hold the plane as in Fig. 105, and, whilst looking down its face, tap the iron. This method allows of a much more accurate adjustment.

PLANING

Examining the Face Side.—Before beginning to plane a piece of wood it should be carefully examined; first, to see whether it is large enough; second, to select the best side, so that on being planed true it will form what is known as the "face side." That side should be examined for any inequalities, a job that may be done in several different ways.

A good method is to place a pair of winding strips on the work as shown at Fig. 107, one being near each end. Then on stooping and sighting ("boning") along with one eye, the upper edges of the strips should appear quite parallel—that is, in one plane, as represented in Fig. 108. If the surface is in wind or twist, the edges of the winding strips will not appear parallel (see Fig. 109). One great advantage of this method over others is that the error is multiplied, as will be seen. Suppose the piece of stuff is 3 in. wide and its surface is a $\frac{1}{4}$-in. winding in its length between the winding strips, and these are 12 in. long, that is, four times the breadth of the surface; therefore, if the strips are boned or sighted so that one end of each coincides as shown on the left-hand side of Fig. 109, then the ends on the right-hand side will be at different levels to the extent of 1 in., as indicated in the illustration. At Fig. 110 is shown the actual winding surface, and at Fig. 111 a trued surface.

Holding the Plane.—With the right hand the toat or handle should be held as shown in Figs. 112 and 118, where it will be noted that the forefinger is extended to the iron. The front of the plane is grasped with the left hand, so that the fingers extend down the far side of the stock, and the thumb is on the near side of it. The position of the body should be such as to give full play to the arms, and at the same time to allow of their pushing the plane in a straightforward direction, and not in a swinging or circular-like motion so common with beginners. Fig. 113 illustrates the general position of the body. The left foot is parallel to the bench, whilst the right foot is nearly at right angles to the left foot. By slightly leaning forward the upper part of the body, the plane of the shoulders making an angle of about 40° with the bench, freedom is allowed for the right arm, and without the elbow coming in contact with the side when using the plane.

Short, abrupt strokes should be avoided; each stroke should be regular, and as long as possible without over-reaching.

The greater pressure should be on the fore part of the plane at the beginning of the stroke, and on the back at the finish of the stroke. This often becomes natural after one acquires the proper position of the body.

Planing for a Face Side.—If it is found that the surface is in twist, the high parts should be planed off first. As it often happens that these are on the same diagonal as shown from A to B (Fig. 110), it is a good method to plane somewhat in that direction at first. A most valuable point to be remembered is that a face side should be produced by as few shavings as possible. This can only be done by frequent testing. Instead of constantly using the winding strips, the surface may be tested for twist with the eye alone, by comparing the front arris of the wood with that at the back as shown in Fig. 114; then for straightness in length by looking down as shown in Fig. 115.

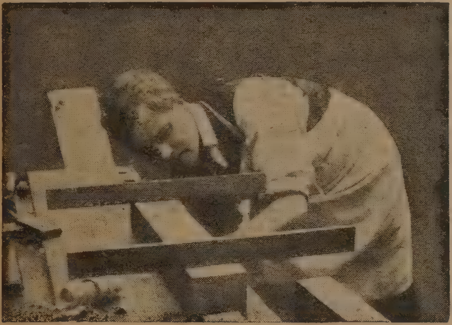


Fig. 107.—Boning or Sighting for Winding of Surface

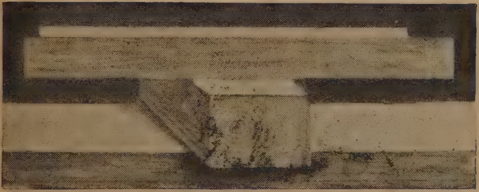


Fig. 108.—Winding Strips Showing Surface True

Another useful method of testing both for straightness and winding is by applying a straightedge diagonally as shown in Fig. 116 on the next page.

A very common way of testing more accurately for straightness across the surface is illustrated by Fig. 117. The outer edge of the blade of a try-square is applied at intervals of every few inches or more, according to the length of the stuff. This alternate testing and planing is continued until the surface is satisfactory. When applying the try-square, keep the brass face of the stock pressed against the face side of the work. A good method of doing this is to place the try-square with the blade some little distance above the edge as represented at Fig. 119; then carefully but quickly slide the stock down until the blade just touches the highest part of the edge, as shown at Fig. 120. A common fault with beginners is to try to adjust the stock and blade in one movement, with the result that frequently the blade fits the untrue edge and the

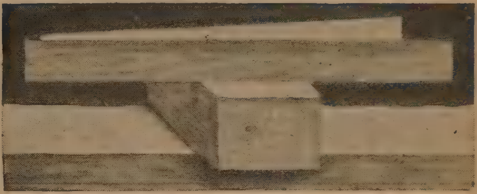


Fig. 109.—Winding Strips Showing Surface Untrue (Exaggerated)

Fig. 110.—Surface in Winding

Fig. 111.—True Surface on Work

stock does not fit the face side (see Fig. 121).

When planing long pieces, which have to be held in the screw, the edges may be tested as shown at Fig. 122. For testing shorter pieces Fig. 123 shows a method often adopted.

The edge of the jack plane can be used for testing, as illustrated in Fig. 123A.

The planing of broad edges will be somewhat similar to planing the face side, and the plane can be held similarly, but when planing the narrow edges of boards, etc., it will be found best to hold the plane with the left hand, so that the thumb is on the top of the stock and two fingers touch the face of the plane and the face of the wood, the fingers in this case being used as a kind of fence, as in Fig. 124. By this means a steadier action of the plane is ensured and a more accurate movement of the iron by keeping its centre

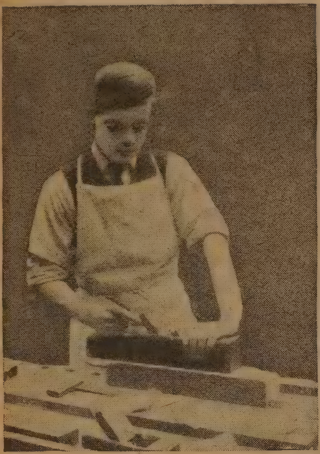


Fig. 112.—Method of Holding Plane: Front View

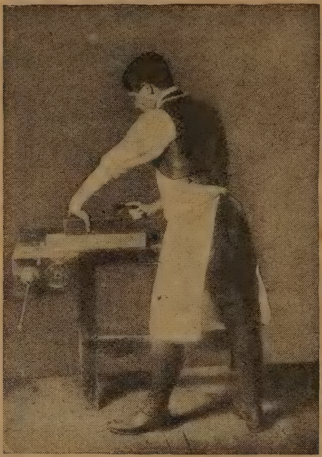


Fig. 113.—Position when Planing

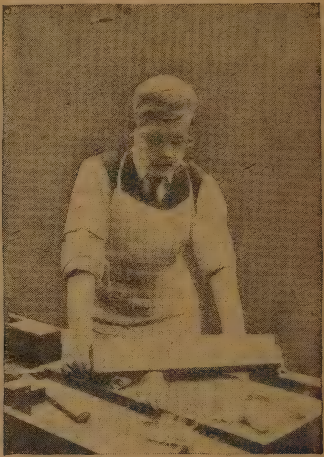


Fig. 114.—The Sighting Test for Twist

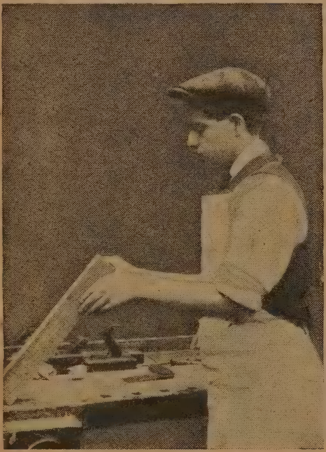


Fig. 115.—The Sighting Test for Straightness

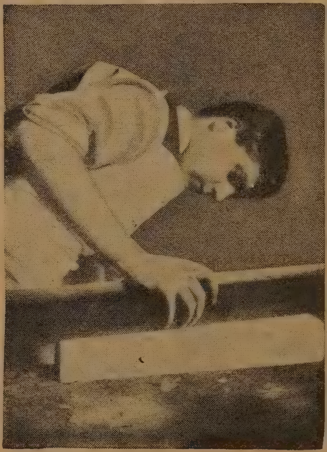


Fig. 116.—Testing with Straightedge

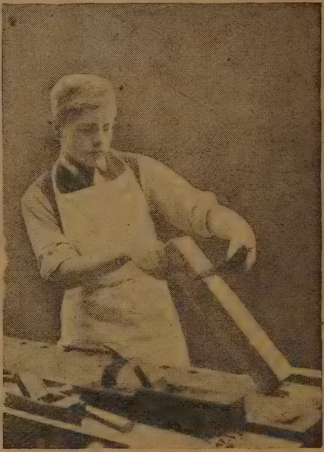


Fig. 117.—Testing Across the Grain

over the centre of the edge and thus producing a shaving of even thickness. The plane should be kept central for the reason indicated in Fig. 124A.

Planing to Breadth and Thickness.—Previous to planing to breadth and thickness, it is necessary to "set" and use the marking gauge so as to have a line to plane to; therefore, the setting and using of the gauge will now be explained. The rule should be picked up in the right hand and the gauge in the left. The screw of the gauge must be loosened, and by movement of the forearms the gauge and rule should be brought into nearly a horizontal position, as in Fig. 125. The distance between the stock and the point of the tooth can be accurately adjusted as required, by pushing forward the stock with the left thumb, or pushing it back with the rule, as may be necessary. When the distance is correct the left forefinger should be pressed on the flatter edge of the stock, as in Figs. 125 and 126, and, turning the gauge to a somewhat vertical position, the screw can be tightened with the right thumb and finger, as in Fig. 126. Having done this, turn the gauge and rule back to the position shown at Fig. 125 so as to test the distance between the point and the stock, to note whether there has been a slight movement due to the screwing up; if there is, it will, of course, have to be corrected. If these directions are carefully followed, and the gauge is not much worn, no difficulty will be found in setting it accurately at once, and this will

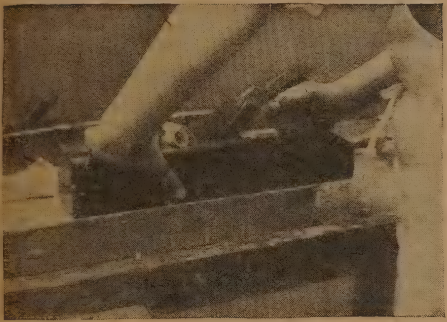


Fig. 118.—Method of Holding Plane: Back View

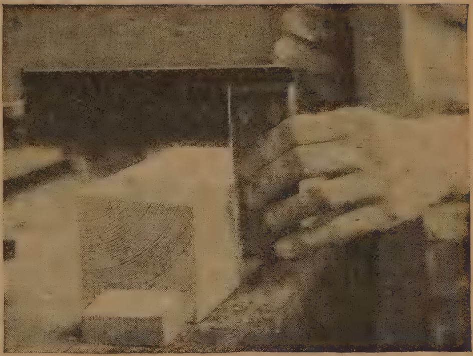


Fig. 119.—First Position in Testing Across Grain with Try-square

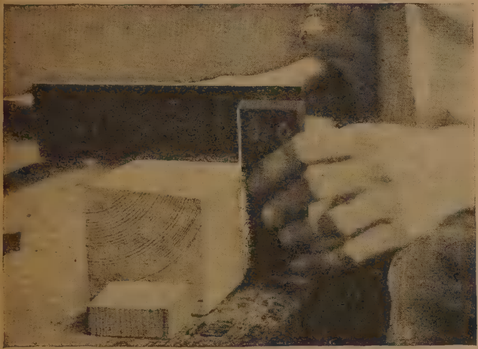


Fig. 120.—Second Position in Testing Across Grain with Try-square

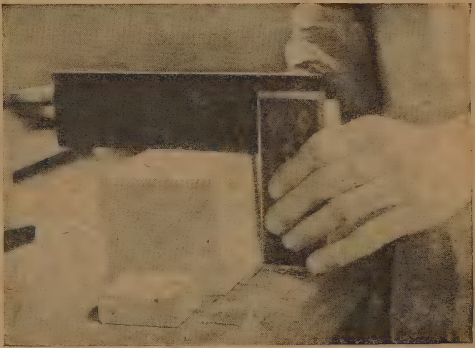


Fig. 121.—Try-square Used in Faulty Manner

obviate the striking of the ends of the shaft on the bench or the work—a common practice with some woodworkers. In the old pattern gauge, where the stock is tightened to the shaft by means of a wedge, there is some excuse for this tapping, but the modern form, with thumb-set screw, lends itself to being set with precision and accuracy. The gauge may be used with the right hand or left hand, as the worker prefers, but the use of the gauge in the left hand will be assumed here.

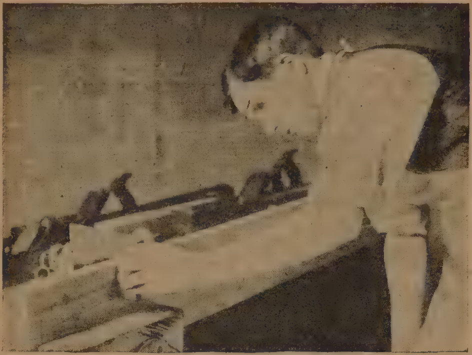


Fig. 122.—Testing Long Strips

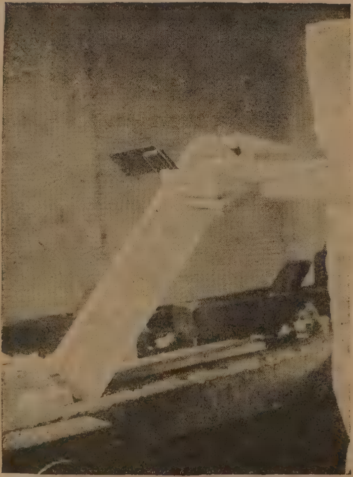


Fig. 123.—Testing Shorter Strips

Holding the gauge in the left hand, have the forefinger on the stock, three fingers against the shaft, and the thumb extended so as to be as near as practicable opposite the spur, where the greatest resistance occurs. This is clearly shown in the illustrations. Then, beginning at the near end, press the stock close to the wood, and, just feeling the point of the tooth touching the surface, push the gauge forward so as to make a very light groove.

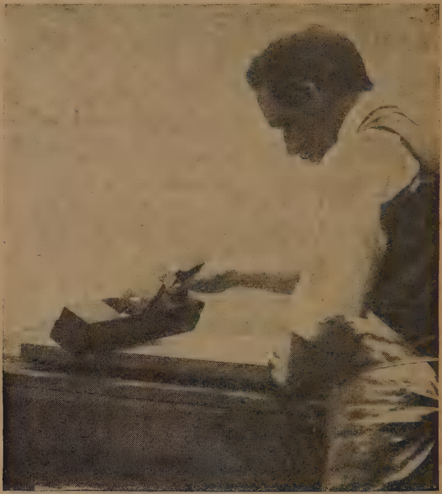


Fig. 123A.—Testing Across a Planed Surface with Edge of Jack Plane

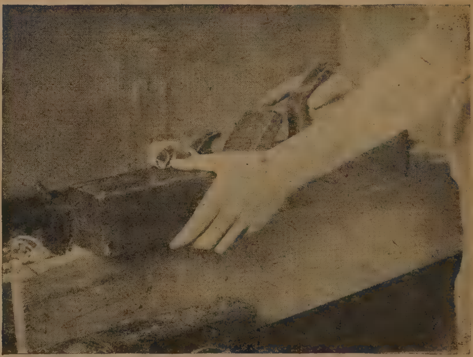


Fig. 124.—Planing Narrow Edge

The position of the hand shown in Fig. 127 should be carefully noted. The most important matter to remember with regard to the gauge is that it requires to be used lightly, because if much pressure is used the tooth is forced into the wood and is almost certain to follow the direction of the grain, the result being a bad scratchy line not quite parallel to the edge of the stuff. When a very light gauge line has been made by a forward stroke, the wrist should be raised, causing the gauge to rotate on the edge of the shaft (see Fig. 128),

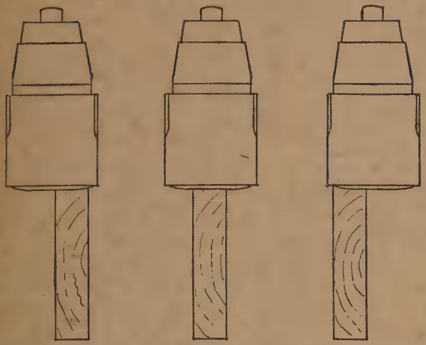


Fig. 124A.—Diagram Showing How Shape of Plane Iron Affects Accuracy of Edge Planed

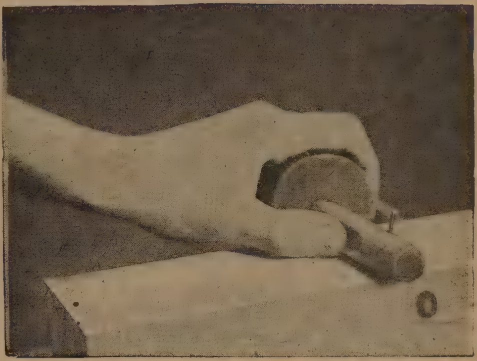
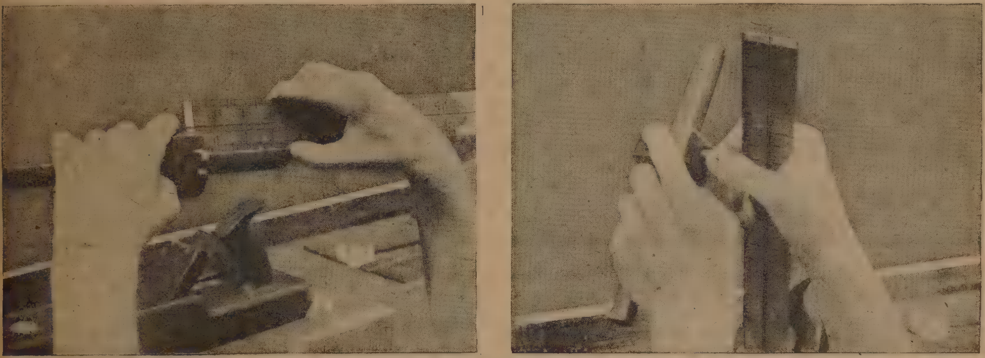


Fig. 127.—Using the Gauge


Figs. 125 and 126.—Adjusting the Gauge

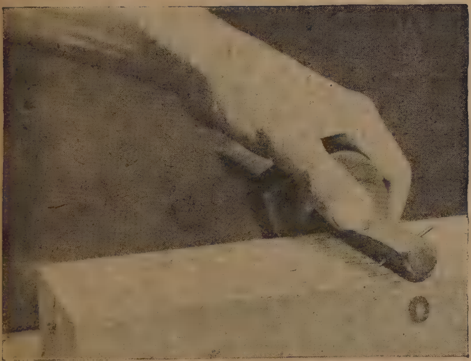


Fig. 128.—Position for Scribing Light Gauge Line

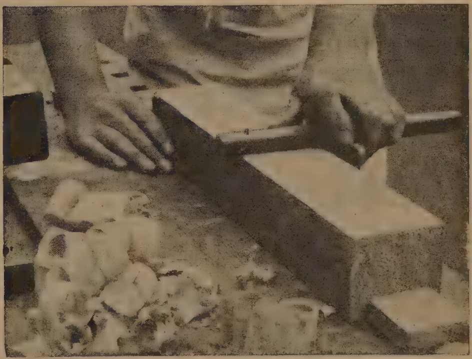
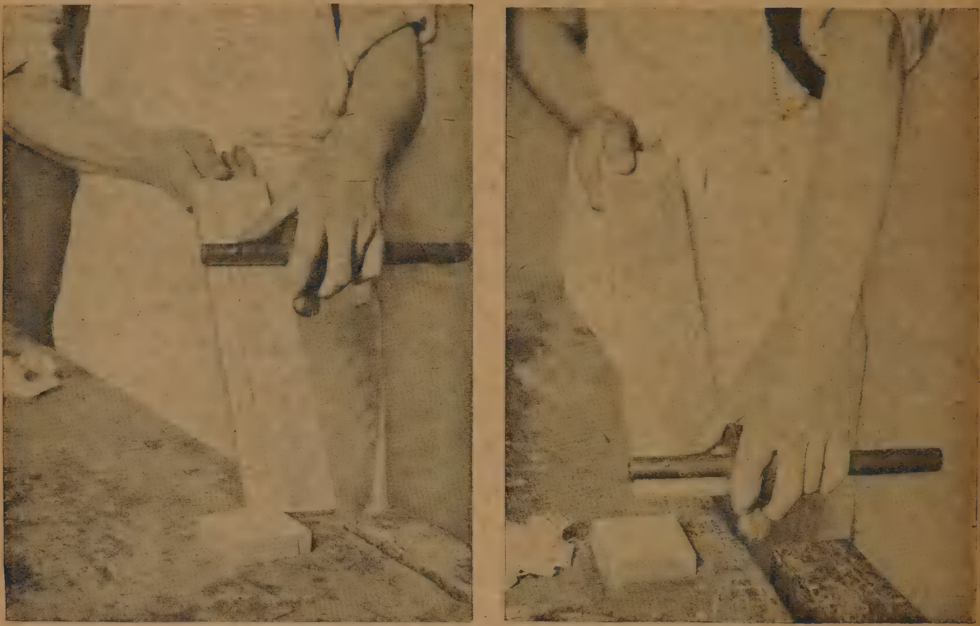


Fig. 129.—Short, Thick Work Against Bench Stop

and thus raising the point of the tooth from the wood. The backward stroke of the gauge should be performed in this manner, and then, by lowering the wrist, the tooth must be brought lightly into contact with the wood, and the groove slightly deepened by another forward stroke. In this way, it will be found that a good gauge mark can be made with two or three strokes. At Fig. 129 is shown the method of holding a short, thick piece of wood against the stop whilst gauging it. For gauging thin pieces of wood it is a good plan to hold them slanting and against the stop as shown at Fig. 130. This allows of a gauge mark being made right to the end without the stock coming into contact with the bench top as shown at Fig. 131.



Figs. 130 and 131.—Gauging Thin Work

Decorating a Room: Washing-off and Distempering

THERE is nothing in the general run of painting and papering which, with a fair amount of practice, the average amateur should not be able to do reasonably well, but it must be remembered at the outset that painters' work, however plain, cannot be done without adequate preparation. Therefore, while later chapters will describe how to do painting and paperhanging, the present chapter is devoted to explaining the best and most sanitary methods of preparing a room for the subsequent decoration, and of distempering the ceiling and walls.

Plant.—All that is necessary in the way of plant are two pairs of steps or short trestles, a good stout 9-in. plank, two pails, two coarse sponges, a washing-off brush (Fig. 16), and a two-knot distemper brush (Fig. 26). The washing-off brush may be dispensed with, as the use of the distemper brush for washing off will have the effect of breaking it in for distempering, that is, the bristles will be worn to a point, so that they will cling together and form a chisel-edge allowing of clean "cutting in" in angles, and close up to the wallpaper. Always buy a good-quality distemper brush, made by a well-known firm, there being no saving whatever in buying cheap, nasty brushes of any kind. After use in distemper, thoroughly wash the brush in cold water, smooth the bristles together, bore a hole through the end of the handle, and pass a piece of string through so that the brush may be hung up until wanted again. Before using, always soak in cold water for an hour, so as to tighten the bristles, should they have become much shrunken in drying.

The illustrations to this chapter show the majority of the brushes and other tools employed by painters and decorators. The amateur decorator will not require many of them, but he will do well to note their names and shapes, and there will be occasions later in this work when it will be advantageous to refer back to this more or less complete collection of painters' brushes.

Washing-off and Stripping.—It is proposed to describe the work of preparing an ordinary bedroom, which has its ceiling and cornice distempered, and the walls papered. Having placed the scaffold in position, begin by wetting as much of the ceiling as can conveniently be reached; wet this several times, so that the water may soak through the distemper. If there is only one coat on the ceiling, it will soften almost immediately; but if, as is often the case, the ceiling has been distempered several times without removing the old coats, repeated wetting and rubbing will be necessary. The plaster must be completely bared, and if the old distemper is very thick, the broad stripping knife (Fig. 57) may be used, care being taken not to dig the corners into the plaster. The chisel knife resembles the stripping knife, but it is not so broad in the blade. Clean off as much as possible with the brush, and finish with the sponge.

The wallpaper should be damped at the

same time, wetting the whole flank of the wall. This should be repeated until the paper shows signs of wrinkling and lifting at the edges, when it should be pulled off, if possible, or scraped off with the broad knife. Where there are several thicknesses of paper, each one may require a separate soaking. The paper having been removed from the side of the room, wash down with clean water immediately, while the wall is wet, to remove any small pieces of paper still adhering, as well as the paste and dirt. Follow this same method all over the room. It is a good plan, when damping the paper, to wet the bottom first, as by so doing, the whole flank of the wall will soak together.

In the ceiling, while wet, bad cracks should be raked, or, if necessary, cut out with the end of an old knife, so that they may afterwards be repaired. In washing-off, the old distemper will collect in these cracks, and make the ceiling appear sound for the time being. Do not trust to this, however, but thoroughly cut them out. When treating the cornice, take care to remove the distemper from the quirks while wet—with the knife, if necessary, or, better, with a shaped strip of zinc—so that the members will show up sharp and distinct.

Treating Stains in the Plaster.—It is necessary to deal with stained places in the plaster, should there be any, where through a leaky roof or other cause the water has percolated through the ceiling. Such stains will frequently show through half-a-dozen coats of distemper. They should be well washed or scrubbed with hot soda water (do not use a good distemper brush for this), thoroughly rinsed off with clean water, allowed to dry, and then be given two coats of white knotting (the pale knotting used by decorators), or two coats of white paint made from paste white-lead, a very little linseed oil, and equal parts of japanners' pale gold-size and turpentine.

Repairing the Plaster.—The walls and ceiling probably require repairing, which may be done with Parian or Keene's cement, both of which allow plenty of time for working, or with plaster-of-paris mixed with alum water, or with a third of its weight of dry whiting and clean water; the whiting retards the setting. Well wet the cracks and other bad places before stopping them, and press the material well home, or it will fall out afterwards; negligence of this precaution accounts for cracks appearing in ceilings soon after finishing them. The broad knife or the stopping knife is the tool for the work, while the plaster may be mixed on a board or on a hawk as used by plasterers.

Examine the junction of the skirting and plaster, as not infrequently the shrinkage of the wood has caused an unsightly crack at this place. This should be filled, and not left for the paper to hide.

Making Clearcole and Distemper.—Distemper is cheap and gives a pure, luminous white, but, as in the case of all water paints, washable or otherwise, it requires a good ground of uniform porosity to show it at its best. When soiled by smoke or age it is easily removed and as easily renewed. Before applying the distemper, ceilings are coated with a solution ("clearcole") to prevent undue suction, so that the distemper itself may be laid on freely without showing the unsightly joins that would be caused by the distemper drying so quickly that the painter could not keep the edge of the work wet, or, as it is called, "alive." Clearcole is made from glue-size, two convenient forms being the double jelly size, put up and sold in 14-lb. kegs, and the powder concentrated size. If the jelly size is preferred, care should be taken to have only that which is clear and of a firm jelly; during hot weather it rapidly becomes putrid, in which state it should not be used. Putrid size has lost its best qualities, and endangers the health of the painter and the occupants of the house. In good condition jelly size is, perhaps, preferable to the powder, the proportions being so easily regulated.

The clearcole may be simply clear size, though, as ceilings are generally rather discoloured, a little of the distemper may with advantage be added. It saves time to make one job of both the clearcole and the distemper, and it is better to make a

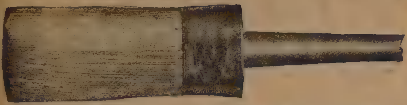


Fig. 1.—Flat Oval Ground Brush

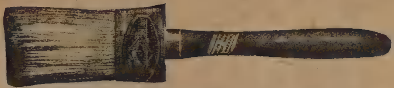


Fig. 2.—Round Ground Brush

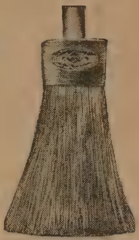


Fig. 19.—Duster

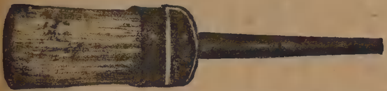


Fig. 3.—One-knot Ground Brush

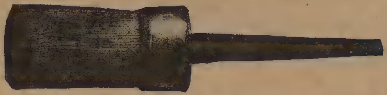


Fig. 4.—Bevelled Oval Varnish Brush

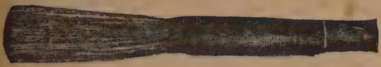


Fig. 5.—Sash Tool, Quilled

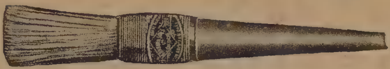


Fig. 6.—Sash Tool, Ordinary Style

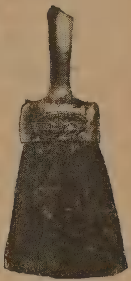


Fig. 21.—Round-set Duster

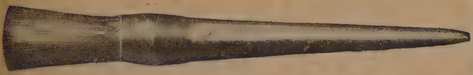


Fig. 7.—Sash Tool, Fork Style

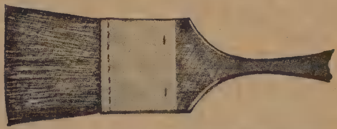


Fig. 8.—Flat Varnish Brush

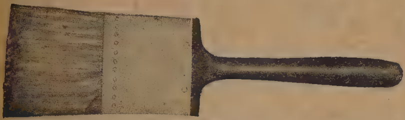


Fig. 9.—Bevelled Varnish Brush

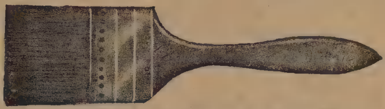


Fig. 10.—Enamel Brush

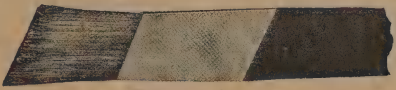


Fig. 11.—Lining Fitch

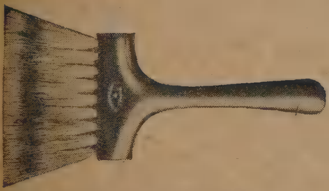


Fig. 12.—Badger Softener

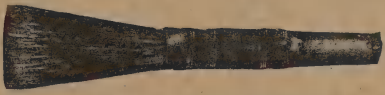


Fig. 13.—Round Badger Tool, Quilled

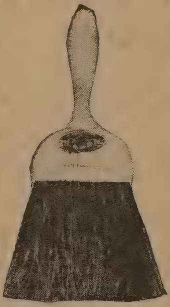


Fig. 20.—Jamb Duster

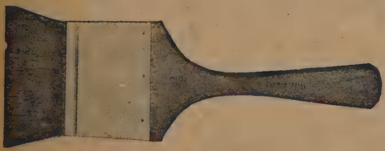


Fig. 14.—Flat Camel-hair Brush, in Tin

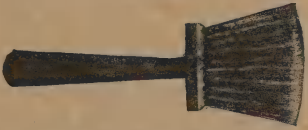


Fig. 15.—Graniting Brush

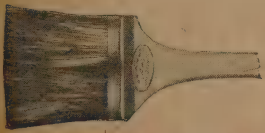
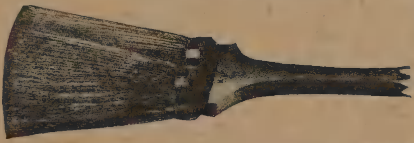
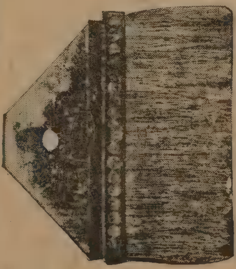


Fig. 16.—Two-knot Washing-off Brush



Figs. 17 and 18.—Liming Brushes, Copper-bound

little too much rather than not enough, as what is left over may come in handy for whiting hearths of kitchens and other rooms; besides, there is generally some cupboard or other place where it can be used to advantage.

Distemper.—To make distemper, take best gilders' whiting, and break up into small pieces enough of it to fill two-thirds of a pail. Fill up with cold water, allow to stand for half an hour or longer, gently pour off the unabsorbed water, and stir the thick whiting with a broad stick or spatula. Take some best double size, break it up fine with the hand, and to it add an almost equal weight of warm water. Heat, stirring the while, until all is dissolved, but do not boil; then into the paste whiting pour the size a little at a time until the pail is full. If desired, the size can be tested by allowing it to cool, adding more size if not thick enough, or more water if too strong. It can easily be dissolved again. The distemper should form a weak jelly in cooling; and in hot weather it may be necessary to immerse the pail in cold water until the contents become of the right consistency, or to add more size to produce this condition.

Before adding the size it is best to tinge the whiting to neutralise the effect of the colour in the size, though, if the clearest kind is selected, the coloration will not be very marked. To obtain a cold white, grind up a little dry ultramarine blue in a small quantity of the paste whiting on a piece of glass with a palette knife or old flexible table-knife, and then stir it into the bulk; for a creamy tint, substitute dry yellow ochre or raw sienna. The whitewash should be strained through canvas or other fairly coarse strainer, and, a little having been poured into another pail for the clearcole, stirred again and stood away in the cellar or the coolest place in the house. If made up as directed overnight, it should set to a loose jelly by the morning. The remainder of the dissolved size should be weakened by the addition of about half as much again of water, and then added to the quantity of distemper saved for the purpose of clearcoling in the proportion of two, or, if the ceiling be not very much discoloured, three to one. This clearcole may be used at once, although it is better if allowed to set to a loose jelly, as it will then be more likely to prevent future suction by remaining on the surface of the plaster.

In the process of setting, the distemper may form a hard thin cake on top; this should be carefully removed before beating up the distemper preparatory to use.

In clearcoling the ceiling, do not be sparing with the material, keep the edge wet, and brush in all directions.

When the powder concentrated size is preferred, the instructions printed on the packet should be followed. Of course, the proportion of water to size is greater than when the tub size is used. When in doubt as to the proportions, use the size strong, allow the distemper to set, and reduce with water to the extent found necessary.

DISTEMPERING CEILINGS

In distempering, work to the light, though in working single-handed it is generally advisable to take the narrowest width of a ceiling when a room is not square. Before beginning, close the windows and doors, the idea being to keep the entire surface as wet as possible while working. Once the ceiling is completed, open the windows so that the whole may dry evenly and as quickly as possible.

Distemper should be applied freely, in short strokes in every direction, though the endeavour should be to hide as far as possible each setting in of the brush. Do not take a wide sweep, but rather a narrow one, and, working from one end of the ceiling to the other, try to keep the edge wet, otherwise when the ceiling is dry every mark where the brush overlapped will show up. Of course, before beginning, it is assumed that the plank and steps are set ready and the furniture removed, so that the scaffold can be moved without any delay. If these hints are followed the ceiling when dry should be level and as white as a sheet of notepaper. Any spots that may have fallen on the painted work or the wall should

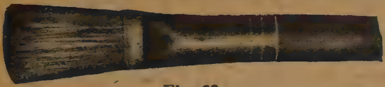


Fig. 22

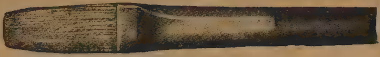


Fig. 23

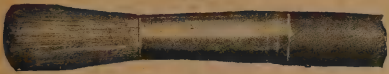


Fig. 24

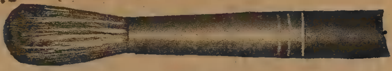


Fig. 25

Figs. 22 to 25.—Hog-hair Fitches, Tin-bound

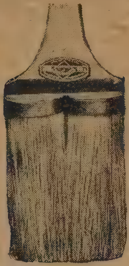


Fig. 26.—Two-knot Distemper Brush

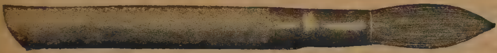


Fig. 31.—Sable Pencil: Large Swan Short

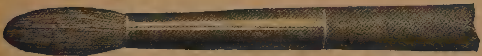


Fig. 32.—Round Red Sable, in Tin

Fig. 33.—Flat Red Sable, in Tin

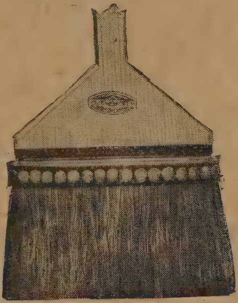


Fig. 27.—Nailed-stock Brush

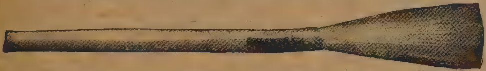


Fig. 34.—Flat-top Swan Writer

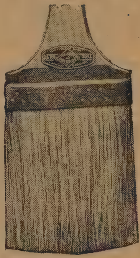


Fig. 28.—One-knot Distemper Brush

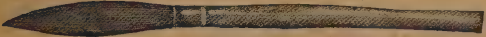


Fig. 35.—Sable Pencil: Goose Writer

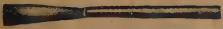


Fig. 36.—Sable Pencil: Crow Writer

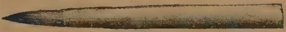


Fig. 37.—Camel-hair Duck Short

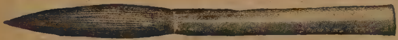


Fig. 38.—Camel-hair Goose Writer

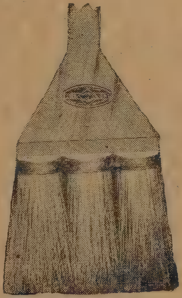


Fig. 29.—Three-knot Brush

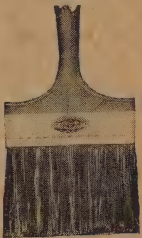


Fig. 30.—Kalsomine Brush

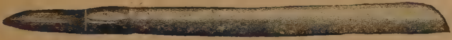


Fig. 39.—Small Swan Short

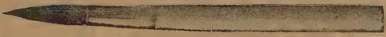


Fig. 40.—Camel-hair Goose Short

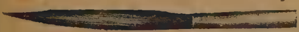


Fig. 41.—Camel-hair Duck Tracer

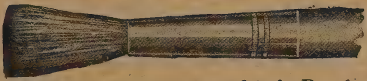


Fig. 42.—Round Camel-hair Brush

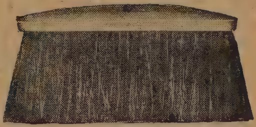


Fig. 46

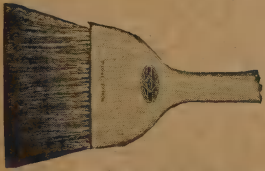


Fig. 45.—Paperhanger's Pasting Brush

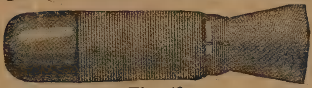


Fig. 43

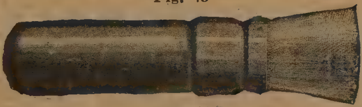


Fig. 44

Figs. 43 and 44.—Stencilling Brushes

Fig. 47

Figs. 46 and 47.—Papering or Smoothing Brushes be wiped off without delay, as it is difficult to remove them when they have been allowed to dry.

Should the distemper appear too thick for use (remember that it is needed thick), thin by stirring in a little cold water.

Take care when distempering not to miss or barely to coat any parts, as after the ceiling is dry it cannot be retouched without showing; the only course to pursue in a case of this kind is to let the ceiling get thoroughly dry, dilute the distemper, and go over the work again.

Occasions may arise when the finished ceiling does not appear of an opaque white, owing to discolorations in the plaster showing through the distemper. The remedy is to go over the ceiling again with dilute distemper.

It frequently happens that it is desired to whiten a ceiling, while the wallpaper, being in good condition, is to be saved. A careful workman will do a job of this kind without leaving a splash on the paper. Sheets of newspaper must be pinned on the wall as close to the ceiling as possible, and any old sheets or cloths that are available should be tacked on the lower parts of the walls. In washing off the old distemper, care should be taken to have the brush fairly dry when rubbing near the edges of the paper, so that the dirty water does not run down the wall in streaks. The sponge should be gripped in the hand, and pressed to a sharp edge, so that it can be run along close to the edge of the paper, yet without touching it.

The beginner finds difficulty in cutting up clean and straight to the paper. For the extreme corners a hoghair fitch may be used; but the remainder may be done, and done best, with the distemper brush. Use the brush flat as a chisel, and push it into the angle. The weight and strength of the bristles will enable the worker to make a cleaner edge than the use of fitch or sash tool will produce. A mechanical aid is a strip of sheet zinc about 15 in. long by 4 in. wide placed close up to the paper and moved along as required. When the ceiling is finished, take down the sheets, and if there should be any splashes on the paper they may be removed by gentle rubbing with a lump of dough.

DISTEMPERING WALLS

In recent years washable paint, sometimes called sanitary washable distemper, has largely displaced ordinary size distemper for walls. Nevertheless, no paint gives purer or more luminous tints than ordinary distemper, its disadvantage being its readiness to soil when in contact with the greasy hand, to gloss in places where it is rubbed, and the necessity of cleaning the plaster bare when renewing the coat plaster each time the apartment is redecorated. It is still largely used, however, and has much to recommend it for many positions, while it is undoubtedly the cheapest article for ordinary wall decoration. In bedrooms, for instance, many people prefer it to wallpaper; and it is certainly in better taste, unless the pattern and colour of the paper are suited to the apartment. Dry walls may be distempered with the assurance that the room will look well for at least two years.

It is not unusual to fix a picture-rail about 9 in. to 12 in. from the cornice, the distance being governed by the height of the room, papering the under part or filling, and distempering the frieze. This is a simple yet effective method, and, if desired, stencilling in one or more colours may be executed on it. Again, where there is a dado and chair-rail dividing the filling from the dado, distemper may be used on the filling with safety.

As with ceilings, distemper to look well must be applied on a ground possessing equal porosity. Too great pains cannot be taken with the ground, for unless this is good, the distemper will not dry out with an even colour, but will display bad, unsightly stains and joins. Places where damp has penetrated the wall and discoloured the plaster should, after the scrubbing, be gone over with a coat of quick-drying white or with white knotting. If the part is a recess or chimney-breast, it may be advisable to paint the whole stretch of plaster to ensure equal suction. Badly damaged walls, or those in which the plaster tends to become loose, are best treated by hanging them with white lining paper and distempering on this ; but if a wall is very much damaged, as is sometimes the case in old houses, the best method is to hang a pattern paper, when the design will to some extent hide the inequalities in the surface. It should be remembered that a plain wall, whether in paper or distemper, always reveals its inequalities more than if a pattern is used.

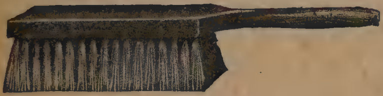


Fig. 48.—Stippler

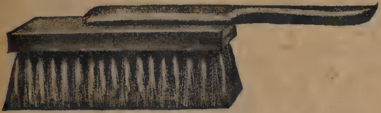


Fig. 49.—Reversible-handle Stippler

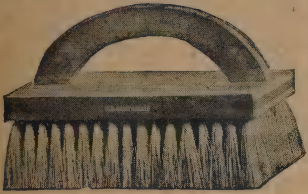
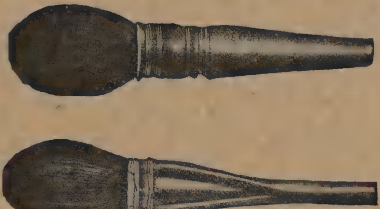


Fig. 50.—Bridge-handle Stippler


Figs. 51 and 52.—Gilder's Mops or Dabs

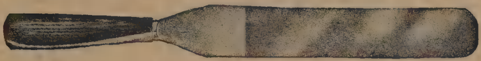


Fig. 53.—Palette Knife

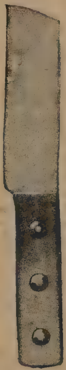


Fig. 54.—Hacking Knife

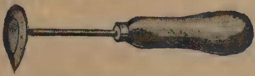


Fig. 55.—Shave Hook

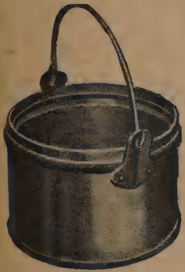


Fig. 56.—Paint Kettle

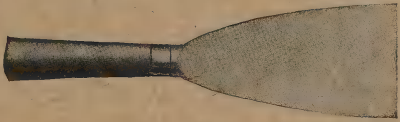


Fig. 57.—Stripping Knife

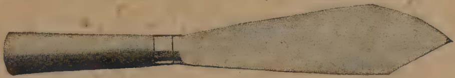


Fig. 58.—Putty Knife or Stopping Knife

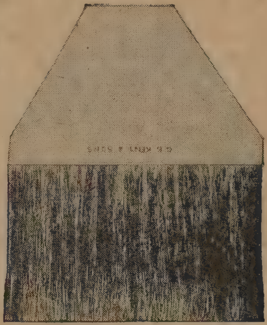


Fig. 59.—Gilder's Tip

Properly, a surface that is to be distempered should possess some suction, though, as is often the case after structural alterations, distemper gives good results on old varnished paint, especially if the gloss on the old surface is first removed by rubbing with pumice-stone and water ; but distemper should not be applied to a freshly oil-gloss painted surface. Very hot walls may be cured by a preliminary coat of thin, sharp-drying paint, or even with a dressing of equal parts boiled linseed oil and turpentine.

Distemper on walls is improved by stippling it while wet, this imparting a pleasing texture. The hoghair stippler is a rather expensive brush, but with care will do an enormous amount of work, and is equally useful for oil, flat, or water paint. It will be quickly ruined if denied proper attention, and therefore, after use in distemper, it should be washed in lukewarm water and hung up by the handle to dry; in water paint with soap and warm water; in oil and flat paint, first in turpentine and then soap and warm water. During use it will frequently get clogged with distemper or paint, and, when this is the case, just the tips of the bristles should be dipped into water, if distemper is being used, or into turpentine if paint, swung lightly to and fro to remove excess of liquid, and then struck on a piece of white lining paper or newspaper. Distempering may, of course, be done without using a stippler, but when applying the distemper, greater pains must be taken to lay the material evenly, and remove as far as possible the evidence of each setting in with the brush. As with ceilings, the worker should brush in all directions, making no attempt to lay off as with oil-painted work.

Walls being exposed to greater wear, and a fair amount of colouring matter being added, more size should be used than in ceiling distemper, so as to ensure the stuff being well bound. The use of too strong size, though, will cause the distemper to chip or flake from the plaster; and if the size is too weak, the distemper will rub off with the hand, or come off in contact with clothing. The error is generally on the side of weakness.

When mixing distemper, all colouring matter must be added to the paste whiting previous to the size, or the colours will not be properly incorporated. Moreover, the size must be hot, while for ordinary whitewash it need only be just liquid. Distemper colours when they are dry appear much lighter, which peculiarity must be allowed for when mixing. A fair idea of the way the colour will dry out may be ascertained by coating a piece of note-paper and allowing it to dry. To ensure a proper test it should be allowed to dry naturally, and not by holding in front of a fire. If too dark, add more whiting, soaking it in a separate utensil; if too light, add more colour.

The colours employed should be either dry or ground in water. In whichever form they are obtained, they should be rubbed up separately on a palette board and not dropped into the pail haphazard and simply stirred; otherwise, when the distemper is strained, it will most likely be found many shades darker than was expected. Powder colours dropped in would not be properly incorporated with the white bulk, and, during distempering, the painter would doubtless be worried and perplexed by seeing innumerable dark streaks, each one where a particle of colour was flattened out with the brush. Sometimes when the distemper is too dark, painters add a little ceiling jellied white, without melting, to the distemper. The colour looks all right while wet; but once dry, even if a stippler has been used, white streaks will show, more especially if the distemper is a deep colour, such as a bright red or blue.

Lime-resisting Pigments.—The following list gives colours that are not affected by lime, and which are safe with whiting and size. The list is not absolutely complete. *Red.*—Venetian red, burnt sienna, rose pink, dutch pink, damp lake, carnation lake, maroon lake, and in addition special lime-resisting reds put up by good colour firms. *Yellow.*—Yellow ochre, raw sienna, italian pink, lime yellow. *Blue.*—Ultramarine, cobalt, azure, bremen, and various lime blues. *Green.*—Lime greens (various), mineral green, terre verte, emerald green, chrome green. *Black.*—Blue-black, lampblack, ivory black. *Brown.*—Raw and burnt umber, vandyke brown. *White.*—Zinc oxide, Orr's white, Charlton white, barytes whiting. Whiting, on account of its utility and cheapness, is the usual base for ordinary size distemper. Gilders' whiting, a finer quality, is worth the trifling extra cost.

As an instance of what is meant by the action of lime on colours, it may be stated that prussian blue added to whiting and applied on a plaster wall will turn in time to a rusty red, whereas ultramarine blue is not influenced in any way whatever.

Mixing Tints.—When mixing tints, much may be learned by experiment. Never stain the whole of the white at first in the hope of hitting on the exact colour required. Indeed, there are occasions where very little white will be necessary, when the usual order may with advantage be reversed, and the whiting added to the pulp colour. It is better to rub a little of each of the colours or stainers required to make the tint on the palette board, and test in a small portion of the white. By this method it is easy to judge the quantity of each stainer necessary for the bulk of white.

Instructions follow on mixing a few of those tints or colours most frequently required. The exact quantities must be found by experiment, though the principal stainer is generally mentioned first. *Stone.*—Whiting, umber, and venetian red, or whiting, umber, yellow ochre, venetian red. *Buff.*—Whiting, yellow ochre, venetian red, and for some shades a little burnt umber. *Old Gold.*—Whiting, yellow ochre, burnt sienna, or venetian red. *Terra-cotta.*—Whiting, venetian red, and yellow ochre, or whiting and burnt sienna alone. *Salmon.*—Whiting, venetian red, and a little yellow ochre. *Grey.*—Whiting, lime blue, venetian red. *Grey* (*warm*).—Whiting, yellow ochre, lampblack. *Grey* (*green*).—Whiting, ultramarine or lime blue, yellow ochre, blue-black. *Green.*—Whiting, lime greens of different shades. These may further be modified by the addition of yellow ochre or raw sienna. *Blues* (*light, cool, or warm*).—Whiting, lime blues modified by the addition of venetian red or dutch pink. *Blues.*—Whiting, ultramarine, bremen, cobalt, or azure blue. *Pink.*—Whiting, and any of the lakes, as damp lake, carnation lake. *Heliotrope.*—Whiting and mauve lake. Whenever convenient, it is advisable to get from a reputable firm a lime colour of the required hue, and simply add it to the whiting.

General Precautions.—The clearcole should be stronger than for ceilings, so as to ensure the second coat producing a solid appearance. To keep a flank of a wall going, it is advisable for two persons to be working on it, one to stipple while the other lays on the distemper. If by accident a spot or splash gets on the ceiling, leave it to dry; then scrape off with a sharp penknife. By no means attempt removal with a wet sponge.

Painting is generally finished previous to distempering, though it is sometimes desirable to leave prominent parts, such as doors, until last. If it is desired to paint the skirting or edges of architraves after distempering, there is a likelihood of the paint leaving a greasy mark, where the oil penetrates the distemper. To prevent this, melt a little clear size, and with a hoghair fitch run round the exposed parts, running $\frac{1}{16}$ in. upon the distemper. When this is dry, the painting may be done without fear of the oil spreading.

Laying Concrete Floor

Instructions on making a concrete path, given elsewhere in these volumes, apply in the laying of a concrete floor. Although some people recommend that, for stability, a concrete floor should be laid in three layers, the upper and lower of strong material, having the bulk of rougher material between them, this plan is not followed to any great extent, and the utility of the intermediate course is doubtful. The finishing coat may, if desired, follow closely upon the laying of the rougher material, but it will be better if the bulk is allowed to set first; and three days afterwards will be a very suitable time to finish off the floor, provided there is no need of hurrying the work forward. After the fine stuff has been ruled off, as soon as the surface begins to get firm, is the proper time to commence finishing-off. A hand float should be used at first, and with this the work should be beaten lightly; then trowel off with light strokes until the desired face is obtained.

How to Make a Pair of Riveted Boots

This chapter, and others on later pages, will provide a complete course of practical instruction in boot and shoe making and repairing. While the present chapter will be devoted to the making of riveted boots, later chapters in the series will describe how to make hand-sewn boots, how to finish new work, and how to do repairs of a varied nature. This chapter is reasonably complete in itself, but part of the instruction here given will become even plainer when regarded in the light which later chapters will throw upon the work.

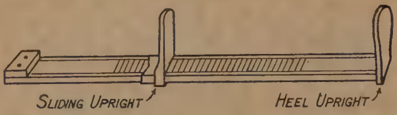


Fig. 1.—Shoemaker's Size-stick

In making a pair of boots to measure, the following are the points of importance in measuring the foot: the length, heel measure, instep measure, and joint measure. The length is obtained by placing the foot on the shoemaker's size-stick (see Fig. 1), the heel of the foot resting squarely against the heel upright (see Fig. 2). The sliding upright at the front of the stick is then moved towards the toes of the foot until the upright just touches the toes. The foot is then withdrawn, whilst the sliding upright is held firm. The number next to the *inside* of the upright is the size, in length, of the foot. But beyond the length registered, due allowance must be made for the spread of the foot. This allowance will depend upon the class of upper being made up, an ordinary upper requiring two sizes extra beyond the stick register, and a stouter upper as much as three sizes allowance. This is really not so much as at first seems, as a size only measures $\frac{1}{3}$ in., there being three sizes to an inch in English measurements for length of foot. Assuming, then, that men's boots are being made, and the foot indicates on the size-stick "size eight," the last selected for an ordinary style of upper would be size ten, thus allowing $\frac{2}{3}$ in. for expansion of the foot when pressure is put on in walking.

The next point is the heel measure. This is obtained by passing the tape round the bottom of the heel (see Fig. 3) and over the extreme top of the instep at the front, the measures being recorded by the inches shown on the tape. The instep measure is next taken by passing the tape under the arch of the foot and over the instep at its highest point (see Fig. 4). The joint measurement is taken by placing the tape round the widest part of the forepart of the foot (see Fig. 5), that is to say, at the "ball" of the foot. This measurement is perhaps the most important of all, and should be taken easily—that is, the tape should not be drawn tightly

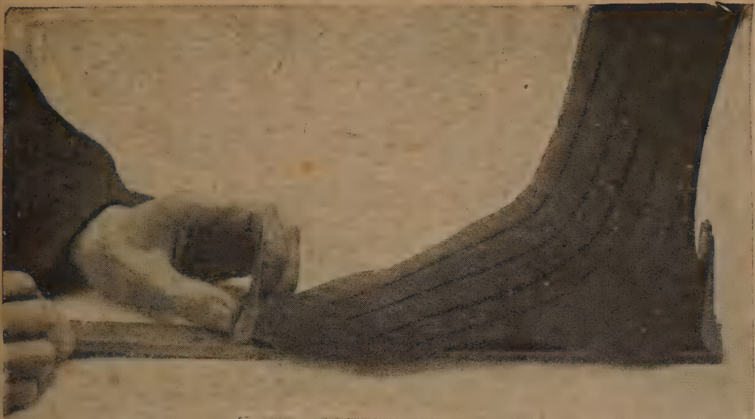


Fig. 2.—Measuring Foot in Size-stick: Note that the heel should rest well against the upright

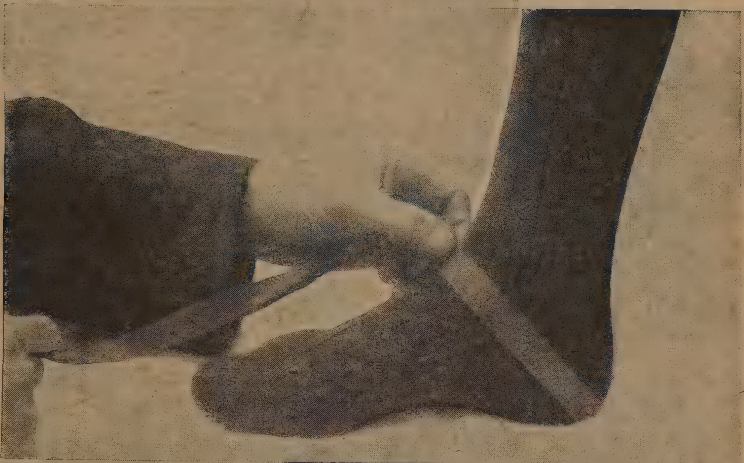


Fig. 3.—Taking Heel Measure: The tape passes round heel and over instep

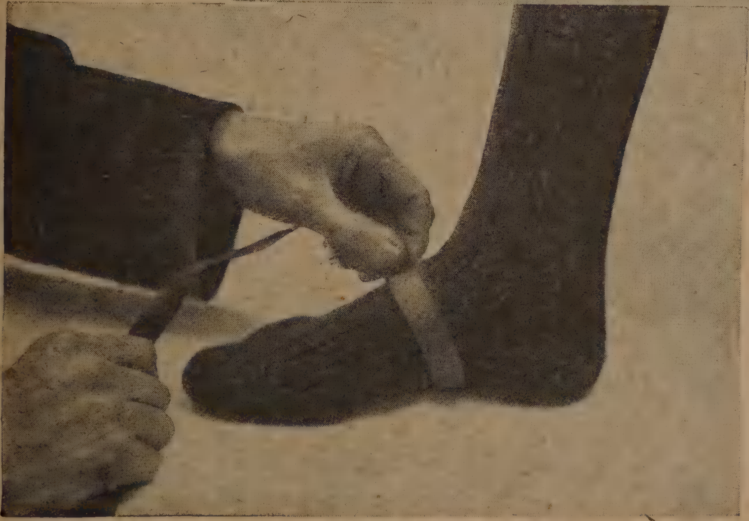


Fig. 4.—Taking Instep Measure: The tape passes under arch and over instep

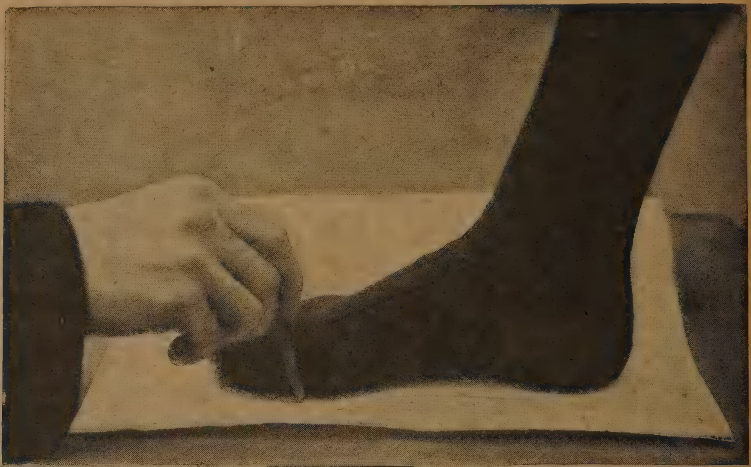


Fig. 6.—Marking Outline of Spread of Foot by means of pencil on a sheet of paper

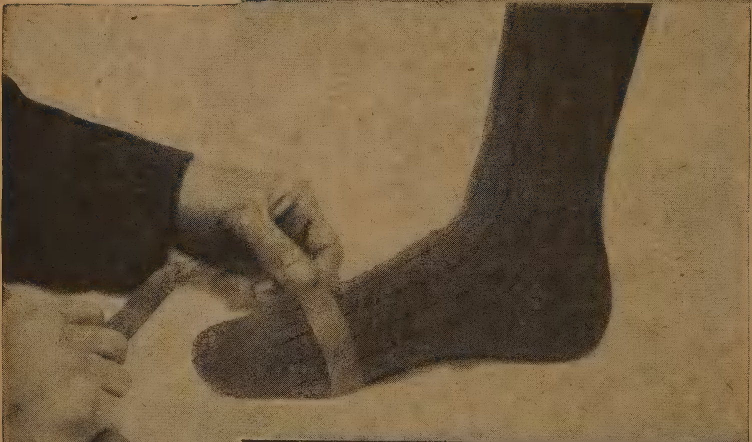


Fig. 5.—Taking Joint Measure: The tape passes round widest part

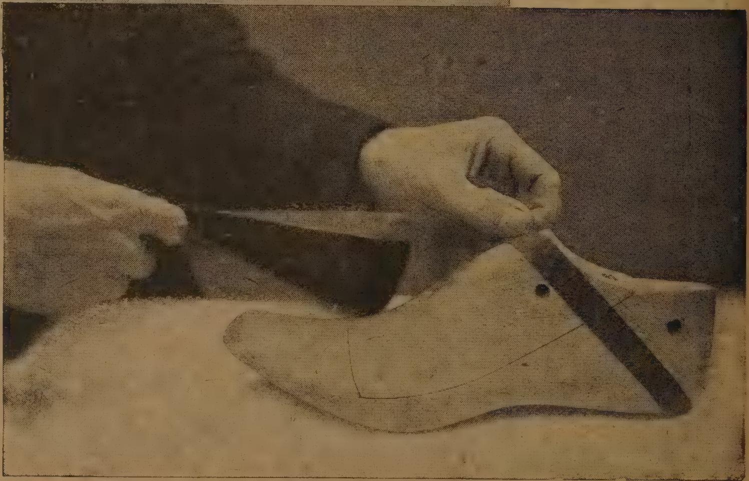


Fig. 7.—Taking Heel Measure of Last: This illustration corresponds to Fig. 3 on p. 39

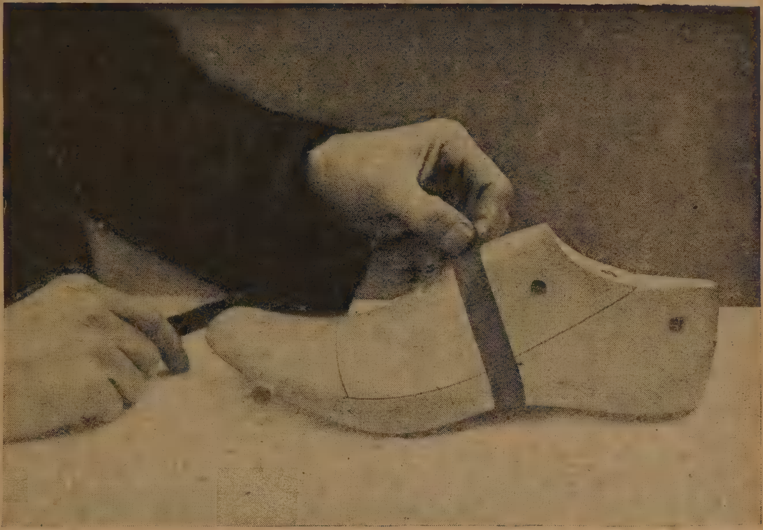


Fig. 8.—Taking Instep Measure of Last: This illustration corresponds to Fig. 4 on p. 39

when taking the measurement at this point.

Selecting the Last.—The style of last used will depend upon the manner in which the boot is to be made. If the boot is to be a riveted one, an iron block last will be necessary. Iron lasts used in making are obtainable in all sizes and in many different fittings, so that, unless the foot is of unusual proportions, no difficulty will be experienced in obtaining a last conforming very nearly to the foot measurements. But there is another point to bear in mind in selecting this iron last. Unlike the wooden last, its shape cannot be altered by " fitting up," though its measurements may be added to by loose " fitting leathers." Now, whilst the iron last may conform nearly to the measurements required, its shape may not be so satisfactory. The foot measured may be wide and flat, whilst the last may be of a narrow build, the iron making the measurements being rather on the *top* of the model than on its *sides*. An outline should be taken of the foot on a sheet of paper (see Fig. 6), and this outline compared with the bottoms of the lasts from which the selection is being made.

Photographs showing how the various measures are obtained on the last are presented by Figs. 7 to 9.

An attempt should be made to obtain a last

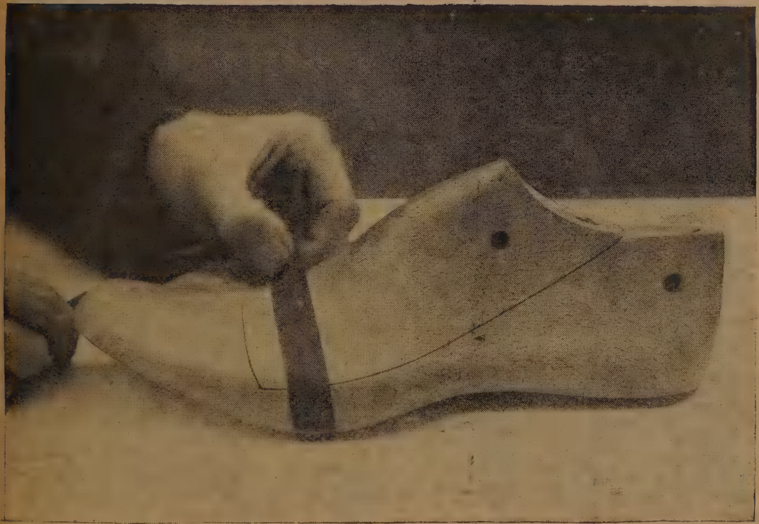


Fig. 9.—Taking Joint Measure of Last: This illustration corresponds to Fig. 5 on p. 40

conforming as nearly as possible to the measurements of the foot, whilst the outline of the bottom of the last should bear some resemblance to the outline of the foot. If the foot to be fitted is of unusual measurements the boot should be made up on the hand-sewn principle; but should the riveted boot be insisted upon, the unusual measurements may be met by obtaining what is known as a "plated" last. This is a wooden last having a metal plate attached to the bottom. By this method the "turning" of the tingles in lasting is assured, whilst "fittings" may, of course, be tacked on the last to suit any requirements. But, in making on a last of this kind, after the upper is lasted the last should be withdrawn and the bottoming proceeded with on an iron last.

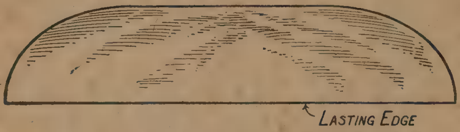


Fig. 10.—Pattern for Heel Stiffener

Fitting the Upper.—The upper will require to be fitted with stiffener, toe-puff, and side-linings. For the stiffener select a piece of firm, light shoulder leather. Measure the upper for length of stiffener, beginning at the joint of the golosh, and passing the tape round the back of the upper to a point directly opposite at the other side of the upper. If the upper has a whole golosh, that is to say, if the golosh has no side-seams, place the tape on the last at a point about midway of the arch, and pass it round the back of the last to its opposite point. The width of the stiffener will be regulated by the depth of the golosh. Cut the stiffener to the pattern shown in Fig. 10. (The dotted line in Fig. 11 shows where the stiffener is fitted.) It must be skived (thinned) down all the way round. Skive on the flesh side, and let the skiving on the bottom, or lasting edge, of the stiffener extend as far as the stiffener is likely to be turned over on the heel of the last (that is, "lasted in"). This distance will depend upon whether the upper is skimpy or generous in material, which point can be ascertained by trying the upper on the last. The toe-puff should be cut the shape of the toe-cap, from a piece of light, firm "cheek." It should be skived a good distance inwards from all edges, leaving the bulk of the substance in the centre of the puff, so that the thickest part of the puff, when fitted under the toe-cap and lasted in, will be well towards the toe end, and falling down the front of the toe. The size and shape of the puff should be such as will permit of its being placed under the cap up to the stitching row, and its edges should be level with the rounding of the toe-cap.

The side linings are intended to prevent the upper from falling at the joints after the boot is made. These should be cut from a piece of basil leather, of a length reaching from the joint to the toe-cap-edge, and about 1 in. in width. These side-linings have to be lasted in with the upper, and they must be placed between the upper and its lining, with the bottom edge of the side-lining on a level with the upper edge. Slightly skive the edges of the side linings, and smear each side with rye flour paste before placing in position. Next damp the stiffeners and mould to shape by "bedding" them round the heel of the last. Apply paste to each side of the stiffener, and insert in position between the lining and the upper. Care must be taken to see that the stiffener extends an equal distance on each side of the upper.

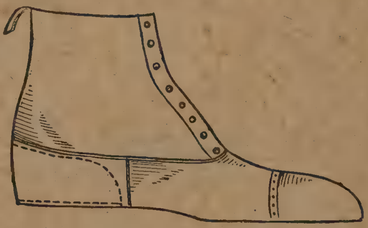


Fig. 11.—Boot Upper, showing Stiffener

Apply paste to the toe-puff, and insert between the toe-lining and the upper front.

Next, take a piece of waxed thread, and lace the upper about three holes, beginning at the bottom lace hole. Tie the thread tightly, dust a small quantity of french chalk on the lining of the upper so as to facilitate the slipping of the upper when lasting, and the upper is now fitted up.

The next point is fitting up the last. The positions where measurements may be required to be increased a little are the instep and joint. Cut a piece of cheek or belly to the pattern shown in Fig. 12. This is termed an "instep leather"; the top portion of the leather is intended to increase the instep measure, whilst the bottom portion will add to the girth of the joints. If, after placing this leather in position on the last, either the joint or instep requires further addition, tack another piece of leather on the instep leather, either on the lower or upper part, according to whether it is the joint or the instep which requires increasing. The instep leather is placed on the last in the correct position for measuring, if the lower or joint portion just reaches to the last where the joint measurement is taken and no farther. This last fitting cannot, of course, be tacked on an iron last, but is held in position by the hand until the upper is placed on the last, the upper itself, after that, keeping the instep leather in position. The final operation preparatory to lasting the upper is attaching the insole. Select a piece of insole leather sufficiently large to cover the bottom of the last. Place this leather flesh side downwards, on the bench. Place the last on the leather, and mark round the last with blue pencil. Cut out as marked. On the last-bottom there is a hole in line with the joints, and another near the toe. These holes are, or should be, plugged with leather. Place the roughly cut insole on the last, grain or polished side next to the iron, and drive a rivet through the insole at the toe and joints, in such a position that the rivets will enter the plugged holes in the last-bottom. If the rivets do not seem to bind firmly enough, withdraw them and drive heel brads in their place. It is necessary that the insole should be firmly fastened, as, if it should slip, the whole form of the boot will suffer.

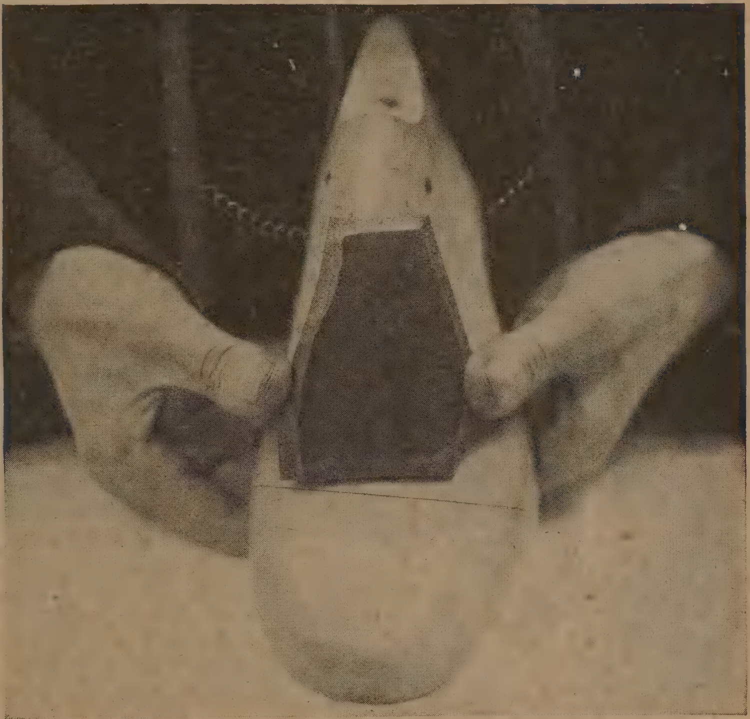


Fig. 12.—Increasing Instep Measure of Last with Leather Packing

Start at the joint and trim away the

overhanging material of the insole from joint to joint. Trim up quite closely to the edge of the last. To round up the inside waist, hold the knife at an angle. Start at the joint and work towards the heel corner, gradually bringing the knife to an upright position as the heel corner is reached. Next, trim round the insole at the outside waist close to the last, slightly bevelling inwards. The heel will be rounded according to the style of heel to be built on the boot. If a full, square heel is intended, the insole will be rounded flush with the last. If the smaller heel (pitched forward) is required, the insole should be rounded inwards at the back and half-way round the heel. Withdraw the rivets holding the insole in position, and use the rounded insole in getting an exact shape for the insole of the other boot. In marking round the shaped insole on the rough insole, the two insoles must be placed either grain side to grain side, or flesh side to flesh side. If this is not done, both insoles will be for the one last, as the grain side must in both cases be next to the bottom of the last.

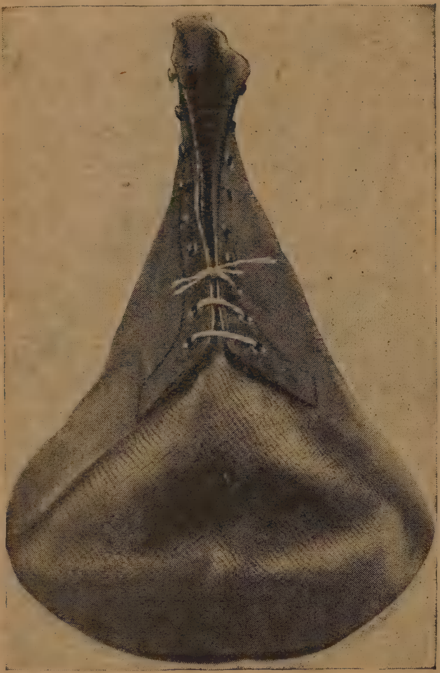


Fig. 13.—Upper Ready for Lasting

Now attach the shaped insoles to the lasts, and proceed to feather the edges. The readiest way, for riveted work, is to lay the rough, flat side of the rasp at an angle on the insole edge, and rasp down all the way round to a "feather." This feather, or bevelling down of the insole edge, should be $\frac{1}{16}$ in. wide, except at the toe and the heel, at which points it should be $\frac{1}{8}$ in. wide. Rub a quantity of french chalk over the lasts, and all is now ready for lasting the upper (see Fig. 13).

LASTING THE UPPER

Lasting the Toe, etc.—The operations involved in lasting will be better understood by reference to certain of the photographic illustrations to the chapter describing how to make hand-sewn boots. Hold the instep leather in position against the last, and, bringing the upper forward, drop the last into the upper. With the right hand, press against the instep of the upper, whilst the left hand is drawn away from the last inside the upper. Let the back of the upper drop half-way down the back of the last. With the lasting-pincers take hold of the centre of the toe-cap, including the lining and toe puff, and pull tightly forward. Next, drive a long tingle through the upper to the insole at this point, but do not drive flush, as this tingle will require to be withdrawn afterwards. Now draw up each side at the edge of the toe-cap, and drive the tingles flush. Next pull up the upper, including the lining and side-lining at the outside joint, and drive a tingle flush. Now draw up the upper (including lining and side-lining) at the inside joint, and drive a tingle flush at this point. Turn the last upwards, and notice if the toe-cap is in a straight position. If it is not, withdraw the tingle at the toe, and one at the side of the cap, and re-last, pulling the cap to the side required to make the lasting of the cap straight. See that the tingles on each side of the cap are driven straight down. Withdraw the tingle at the toe centre, and turn the toe-cap back towards the instep. Now take hold of the upper (including the toe-puff and lining) and pull the centre forward as tightly as possible. Tingle down. Make an incision through the upper, puff, and lining, immediately behind the tingle to the right hand. Take hold of the material to the right of the incision, pull firmly upwards, and at the same time twist the lasting pincers inwards towards the centre of the last. Tingle down, make an incision to the right of the tingle, and proceed as before until the tingle at the toe-cap side is reached. Next make an incision through the material to the left of the centre tingle, pull up, tingle down and proceed as before. The result of making these incisions in the material, and twisting the lasting pincers when pulling up, will be to lay the pleats evenly on the edge of each other. Next cut away the surplus material of the pleats, tap the lasting down with the hammer, and pull the toe-cap back into position. Pull the toe-cap up firmly with the lasting pincers at the centre, drive a tingle flush, and then proceed to last the cap as described in lasting the upper, puff, and lining.

Lasting the Heel.—Take hold of the upper immediately at its centre at the back of the heel. This will be rather difficult, as it will be in its first position (half-way down the back of the last), and if the front of the upper has been well lasted, the back of the upper will bind tightly to the back of the last. If it is not possible to get a good grip with the lasting pincers whilst the upper is in this position, insert the lifting-awl between the lining and the back of the last, and ease the upper upwards until there is sufficient for a grip with the pincers. Now pull the back up tightly. Before tingling down, take hold of the lining and pull up tightly at the back. Without releasing the hold, twist the pincers and pull the lining to the right. Again twist the pincers and pull the lining to the left. If this operation is not performed, it will be found, when the last is removed from the boot, that the heel lining is wrinkled, and this would cause discomfort to the wearer. Having pulled up the lining, turn the upper down on to the insole at the back, and drive a tingle flush. Repeat this operation at each corner of the heel. The rest of the heel will be easily turned down, and the work will be facilitated by using a small hammer. It will be noted that the pulling up of the heel is accomplished when the back is pulled up, as the rest of the heel comes up at the same time. It is, therefore, only a question, once the heel is pulled up, of cleanly laying the lasting on the seat of the last.

Lasting the Inside Waist.—Take hold of the upper and lining about the centre of the waist, and pull up as tightly as possible. The upper must " bed " snugly against the last, so that the curve and shape of the waist is prominent. Whilst holding the upper in this position, drive the lifting-awl through the upper and into the insole, placing the lifting-awl just behind the nose of the pincers. The upper can now be kept in position by simply holding the lifting-awl firmly down by the left hand. Release the hold of the pincers, and lay and tingle down the upper in the waist on each side of the lifting-awl. This done, withdraw the lifting-awl. This method of lasting the waist will be found to be effective even in lasting the strongest uppers. If, after lasting, a " bunch " should occur at the joint tingle, withdraw this tingle, and re-last the joint.

Lasting the Outside Waist.—There now only remains the outside waist to be lasted. This will easily fall into position. The tingle at the outside joint must be withdrawn if a bunch appears, and the joint pulled up afresh. Tap down the upper between the joint and side cap tingles, and drive one or two tingles on each side, and the lasting is completed. Pull out the nails holding the insole down to the last. The boot is now ready for the shank-piece and bottom filling.

The Shank-piece.—This is a piece of leather fixed in the waist, extending from the back of the heel to the joints. It is intended to give firmness and spring to the waist of the boot. Many different kinds of shank-pieces have been tried, and in some makes of boots steel is used instead of leather, whilst wooden shank-pieces in the cheaper kinds of boots are quite common. The best shank-piece, however, is cut from a piece of stout sole-leather (see Fig. 14). Cut the piece long enough to extend, as previously stated, from the back of the heel to the joints. It should be about 1 in. in width. Skive down all edges, and tingle down in position with the skived side upwards.

Bottom Filling.—Next fill up the forepart between the edges of the lasting (that is to say, all that part of the insole not covered by lasting the upper) with rough patching leather. The best filling for this purpose is calf, or kip offal. The filling must not be of greater bulk than the lasting of the upper—the idea being to bring up the centre of the insole to a level with the lasting edges.

BOTTOMING THE BOOT

Attaching the Middle Sole.—This is the first operation in bottoming a boot. Great care should be taken in rounding-up the middle sole, as careless rounding will spoil the whole appearance of the boot (see Fig. 15). Once the middle sole is attached and rounded, the sole will have to carry its defects, as the sole must be rounded-up by the middle. Select a piece of light shoulder long enough to reach from the toe of the boot to the joints, with an inch to spare. Shape the leather roughly, but leave enough to round up to shape properly after the middle is attached. Skive the waist—that is, the end which will go across the joints. It does not matter whether the flesh or grain side is skived, but the middle sole should be placed with the *grain side next to the lasting*. Tingle the middle down by placing a tingle at the toe, and a couple at the joints. In rounding the middle it should be remembered that the tendency to overtread is usually on the *outside* joint. It should also be noted that the amount of material to be left on to form, as it were, a welt, will be drawn in a little by the tingling-down process, and due allowance should, therefore, be made for this "drawing in." Starting rounding at the outside joint, allow ½-in. surplus from the commencement, gradually working down to ⅜ in. by the time the corner of the cap is reached. Continue the rounding to this allowance, round the toe and down the other side of the boot, until finishing up at the inside joint. There will thus be an extra middle width at the outside joint, and an even width on the rest of the forepart. Mark round for the tingling down, and in so marking go far enough inwards to avoid the tingle-heads forming an obstruction to the rivets when the outer-sole is being attached. The tingles need not be less than ½ in. apart. Hammer down, and examine the middle for final rounding. To do this, it will be necessary to "beat up" the forepart.

Beating-up the Forepart.—The "beater" is a tool something like a rasp, slightly turned at one end. Place the bent end against the upper at the joint, the hollowed side next the upper, and the top-end edge pressed firmly against the middle sole. Tap the beater gently with the small hammer. Whilst tapping, at the same time be sliding the "beater" round the boot until the whole of the forepart is beaten up. It will then be easy to see the irregularities in trimming-up the middle sole, and the trimming may then be correctly completed.

Attaching Felt.—Now cut a piece of felt to the shape of the middle sole, but on a smaller scale. This felt may be procured at the local leather shop, and its use is to prevent creaking of the boots in wear. The felt will be easiest cut if a hot knife is used. Tingle the felt into position, and the boot is ready for attaching the outer sole. As some little difficulty may be experienced in getting both middle soles for the two boots exactly alike, it is a good plan before laying on the felt to take a paper pattern of the first middle, which can be used as a guide when rounding up the second middle sole.

The Outer Soles.—Having got both boots lasted, and middle soles attached, the cutting out of the outer soles next demands attention. Turn the sole leather flesh side upwards, so that any "flay-marks," or cuts, may be visible and be avoided in marking out. Lay the left boot on the leather, and then place the right boot by its side in such a manner that the heel of the right boot is on a level with the toe of the left, and the outside joint of the right boot fitting close up to the inside waist of the left boot. By this method the long soles will be cut out with the least waste of material. Mark round the boots with blue pencil. Cut out the soles thus marked, and soak well in water. When mellow, examine the substance of the two soles. If one sole happens to be stouter at any point than the other sole, trim off the surplus substance until both soles are as near as possible of equal and regular thickness. Hammer the soles on the lap-iron.

Tack on the sole by driving a rivet at the centre of the toe. Drive this rivet flush. Now take hold of the sole at the waist and pull tightly towards the heel. Drive two long rivets at the joints in such a manner that they may afterwards be withdrawn. Take hold of the heel part of the sole. Pull tightly forwards so as to take the draught from the waist. Hold the leather down firmly, and drive two long rivets at the inside waist, and two at the outside waist. Next drive a couple of rivets flush at the heel. Now tap the sole down well in the waist, to bed it to the contour of the boot waist. Start rounding up the sole at the joint. Trim up level with the edge of the middle sole from joint to joint. Next shape the inside waist. Let the lasting edge be the guide for the shape. Next trim up the outside waist, following the line of lasting for a guide as in trimming the inside waist. Round up the *sides* of the heel almost flush with the seat for half the distance from the heel corners to the back. Then hold the knife at an increased angle, and round the rest of the heel portion slightly inwards. This will give the necessary pitch to the heel. Run the rasp round the sole edge. Using the back of the knife point, start marking for the rivets at the outside joint and continue round to opposite joint. Judge the distance inwards on the sole for the riveting mark by the width of middle allowed. Mark far enough inwards for the rivets to penetrate the insole $\frac{1}{8}$ in. from the feather edge. Gradually take this mark inwards, going towards the joint at each side, so that the waist mark will merge into the forepart mark at each side of the joint. Mark round the heel so as to allow of the rivets penetrating the insole $\frac{1}{4}$ in. from the feather edge. Drive a rivet at the toe, one at each joint, two at each side of the waist, and one at each corner and at the back of the heel. Withdraw the tacking on rivets, and rivet round. For ordinary walking substance, use brass rivets, $\frac{5}{8}$ in. long for the forepart, and $\frac{1}{2}$ in. long for the waist. Use $\frac{9}{16}$ in. iron rivets for the heel. Let the rivets be $\frac{1}{4}$ in. apart all round the sole. Hammer down the bottom carefully, file the rivet heads from the heel to the waist, and mark off the seat for the heel. Measure from the extreme back of the heel a distance of $3\frac{1}{8}$ in. and make a line across the seat at this point.

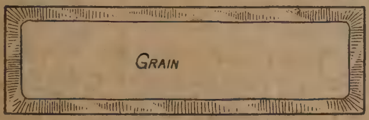


Fig. 14.—Shank-piece

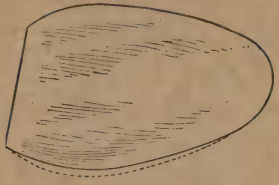


Fig. 15.—Middle Sole

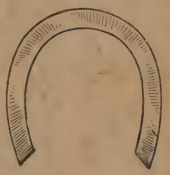


Fig. 16.—Split Lift

The Split Lift.—Cut a strip of leather $\frac{3}{4}$ in. wide, and of a length sufficient to reach from heel-corner to heel-corner with 1 in. to spare. Soak the strip, work it backward and forward between the hands until it is limp, and lay it on the cutting board, flesh side upwards. Hold the knife at a slant at middle the distance of the width of the strip, and skive from this point in such a way that the knife works through at the strip edge and makes two wedge-shape strips from the strip of leather. Hold the two ends of one of these strips between the left finger and thumb, the thin edge of the strip being to the inside. Lay on the lap-iron and gently tap down the thin or skived portion, whilst holding the ends together until the rand assumes the shape of a heel (see Fig. 16). Now place the rand (or "split lift") on the seat of the heel, taking care that its outside edge is flush with the rounding of the seat, and also that the two ends extend beyond the marking-line of the heel. Fasten down with a few tingles. The split lift raises the edge of the seat level with its centre.

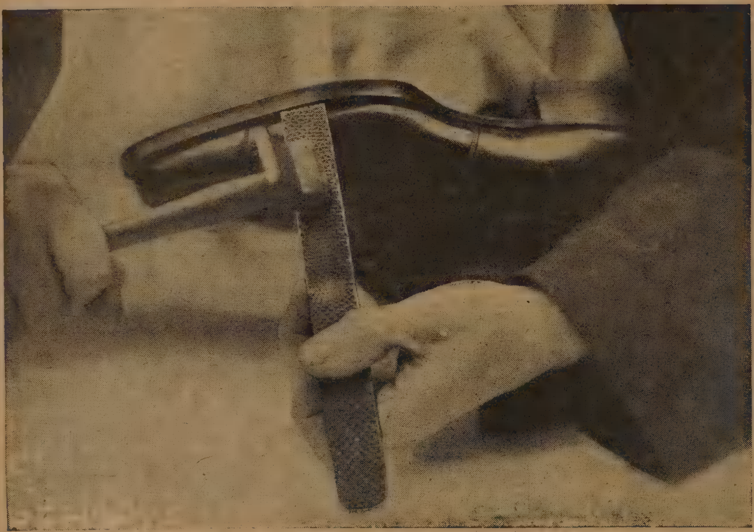


Fig. 17.—"Beating-up" the Upper

Building-up the Heel.—Round-up the split lift level with the seat, and take a paper pattern for the next lift. Cut out the lift, attach, and round up with a slight inward slant. Build up the heel in this way until the heel measures $\frac{7}{8}$ in. from the edge of the heel part of the sole next the lasting to the top of the last lift. Drive a row of 1-in. iron rivets round the top lift; the heel is then ready for the top-piece. Paper patterns should be taken of each lift after rounding, for guidance in building up the heel of the other boot. Trim up the heel as uniform as possible. Take a paper pattern of the top lift, from which to cut the top-piece, and then soak and hammer the last-mentioned. Drive two long rivets near the front of the heel in the top lift, and one at the back. Leave these rivets standing up about $\frac{1}{4}$ in., and cut off the rivet heads with the cutting-nippers. Lay the top-piece in position on the top lift. Hit the top-piece smartly with the heavy hammer. The rivets in the top lift will penetrate the top-piece and hold it in position firmly for rounding. Trim up the top-piece level with the top lift. Do not slant the knife inwards at all. Place a rivet at each corner of the heel, and one at the back. Mark round from the corner of the heel to the outside of the boot, and discontinue the marking when just round the heel at the inside. Place a row of rivets closely on the line. On the inside of the heel place a rivet between the corner one and the last one driven on the line. Pare away the surplus leather in the breast of the heel, making a slight curve. Hammer down the top-piece. Next beat up the upper (see Fig. 17), and continue the beating-up all the way round the boot. Cut the wax-thread lacing, take out the block of the last, then withdraw the last itself, and insert a wooden last, ready for finishing.

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China Restoring and Repairing

The methods and materials employed in restoring china are largely governed by the object of the restoration—whether to complete a show specimen not meant to be used or even scarcely handled, or whether to repair a piece of utility china of which years of useful work are expected. The restoration of old china for show purposes will first be dealt with.

It may not be generally known that only a few types of antique ceramics are valuable and, what is more, saleable. When in fragmentary or badly imperfect condition, slight discrepancies may be overlooked by the collector; but when buying a damaged specimen, providing that all or nearly all the pieces are present, it is safe to reckon the value at not more than one-quarter that of the piece in perfect order. It is in the buying of damaged specimens of this character, however, that the poor collector stands the chance of adding to his cabinet examples which would never otherwise be represented. Take, for example, Worcester with the square mark, or Chelsea with the gold anchor; porcelain which, when perfect, is often sold at auction for three or even four figures. Many of the large antique dealers have imperfect specimens for sale for a few pounds, sometimes shillings.

The work of restoring old china demands in many cases the exercise of considerable technical skill, coupled with an adequate knowledge of the use of the colour-box. There exist a few professional menders whose work is so fine that it is difficult to distinguish the counterfeit from the original; but in the ordinary way repairs are all too apparent.

RESTORING OLD CHINA

Repairing Fractured Plates.—The joining-up of simple fractures in plates, dishes, and other specimens in which the decoration does not entirely cover the white surface of the body, is seldom satisfactory. However carefully it may have been performed, the minute crevices occurring between the edges of contiguous fragments are filled with dust, the result being the occurrence of thin black lines. In soft-paste porcelain, moreover, the edges of original cracks are rendered still more unsightly by the staining of the body by liquids which have been contained in the vessel. Derby, Worcester and Chelsea tea-ware is often badly marred in this way.

Much of this unsightly appearance may be obviated by the use of a suitable adhesive. Fish-glue in any shape or form, if used without subsequent treatment, is seldom satisfactory; it is most susceptible to extreme dryness, becoming brittle, and equally so to atmospheric moisture, under the influence of which it softens. Moreover, the very nature of the material appears to exercise an attraction for dust, and joints made with it, however neat and inconspicuous at the time, soon become apparent. Much has been said about the merits of patent preparations which are supposed to be as good as a liquid porcelain. While many of them appear to offer immense possibilities for the work of restoring missing parts, etc., they are chemically unstable, the liquid vehicle appearing after some months on the surface in the form of flocculent matter.

Waterproof and colourless adhesives having naphtha, xylol, benzole, etc., as solvents, together with others requiring heating before use, invariably become very brittle with age and complete dryness.

The most satisfactory material—one that has long since been used by professional restorers—is flake-white oil colour, as sold by artists' colourmen in tubes. It is not strongly adhesive at first, drying rather slowly, but becomes very hard and tenacious with age, and is wholly waterproof and non-susceptible to atmospheric conditions.

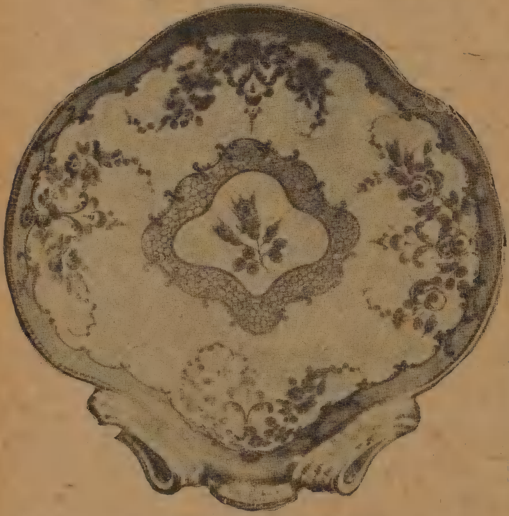


Fig. 1.—Worcester Dessert Dish Restored from Seven Fragments

Restoring Specimen Broken into Many Pieces.—It is a tedious task to restore a specimen that has been broken into many pieces, it being necessary to bring two or three fragments together at a time, bind them with cotton, and keep them so for a few days. If, however, a start is made simultaneously with several different parts, the mending of the whole is greatly simplified. Before any attempt is made, however, to join old fragments, they should be well washed, especially on the broken edges, a nail-brush being used to remove every particle of dirt. If an original breakage has been mended by means of rivets it should be taken apart, and the rivets removed. The Worcester "gros bleu" and "salmon scale bleu" dessert dish shown in Fig. 1 was restored in this manner from seven separate fragments, and no fewer than twelve rivets were removed from it. The actual extent of the fracture is hardly noticeable from the show side, owing to the fact that the joints, after being carefully cleaned up, were covered with a very narrow band of oil colour carefully matched to the prevalent hue, and heavily loaded with medium.

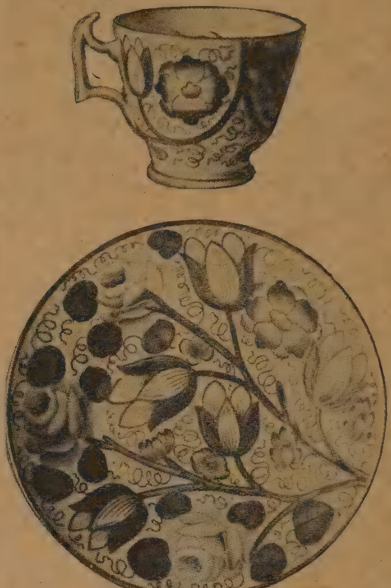


Fig. 2.—Chamberlain Worcester Cup Restored from Fifteen Fragments, and Saucer from Three

The Chamberlain Worcester cup (Fig. 2), profusely decorated, had been broken into fifteen pieces, and the saucer into three. The adhesive used in this case was ordinary fish-glue; but, on drying, a ten per cent. solution of formalin was applied to the inside and outside of the cup, with the result that the glue was rendered almost insoluble and less affected by extreme dryness. Minute seams of colour, however, were afterwards applied above the cracks, and the specimen after the lapse of several years appears to be quite sound. A highly decorated specimen of this character, however, affords more satisfactory results than one having wider expanses of white ground, the cracks being far less in evidence upon colour.

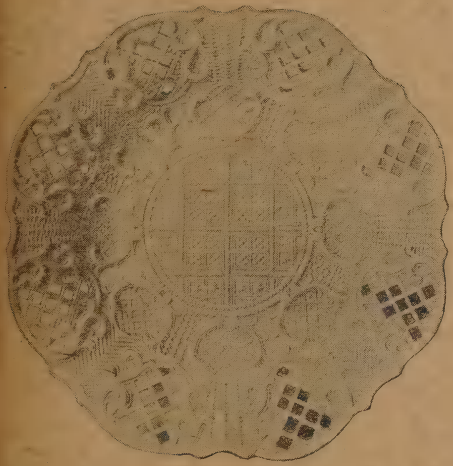


Fig. 3.—Trellis Border Salt-glaze Plate with Portion of Rim Restored in Plaster

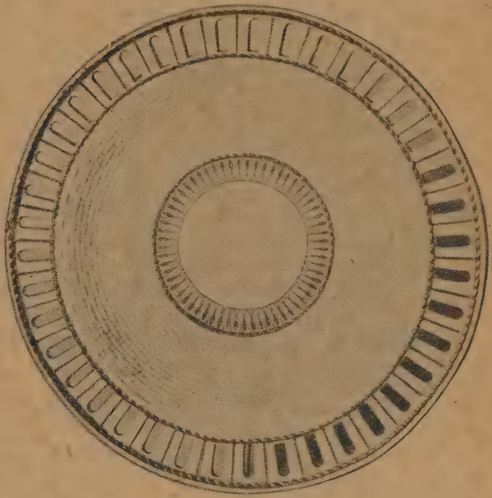


Fig. 4.—Plate by Lakin and Poole, with Section included by Seven Bars of Border Restored

Moulding Missing Fragments.—The work of restoring missing fragments by means of a composition falls under two distinct headings. In the first, the remainder of the specimen affording an accurate guide to the nature of the lost piece, it is possible to restore by means of modelling. A simple example of this character would be a plate, saucer, or bowl from which a portion of the rim is missing.

In the second method there is no such indication, and the worker has to rely solely on his idea of the fitness of things. Apart from the task of redecoration, this type of work may be considered the most difficult. The character of the composition itself depends largely on the class of work to be performed. If the specimen can be placed immediately it is finished in a cabinet or showcase, and not subjected to rough handling, plaster-of-paris may be used with advantage; but if this protection is not available it will be necessary to employ a more durable substance.

Dealing with the possibilities of plaster, first it should be stated that the material is really suitable only for casting into a mould, and hardly admits of much subsequent working. Presuming that a plate of the openwork trellis border variety (see Fig. 3) has a portion out of the rim, the mode of procedure would be as follows: A piece of strapping plaster is first stuck on to the lower surface of the rim, on a section of the plate having similar decoration to the missing piece. The edge of the strip of plaster is allowed to project somewhat away from the edge. A dam of putty or clay is then built up to enclose a section of the border, larger than the missing piece, this passing over the edge of the plate and continuing along the margin of the strapping plaster in such a way that the periphery of the section is included. It follows that a roughly constructed casting-box is the result. Hard paraffin-wax, melted by heating in a water bath, is now run in and allowed to set completely, this finally producing a perfect and sharp impression or mould of the section complementary to that partially missing. In many varieties of plates with open-work borders, salt glaze, Wedgwood, etc., it may be found that, the perforations having been made separately by hand, some little difficulty may be experienced in fitting the mould to the damaged section. If the edge of the plate is slightly warmed, however, the wax will generally adapt itself; but care must be exercised to prevent the surface of the mould itself from being affected. Once the mould has been fitted perfectly into place, strapping plaster should be used to fix it. The plaster may now be mixed and run into the mould, so as completely to fill up the gap. If a weak solution of gum arabic is used instead of water, the plaster will ultimately become very tough.

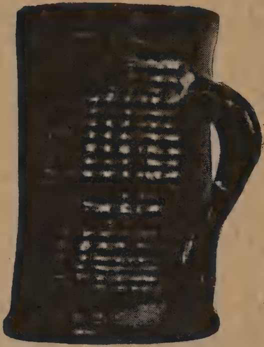


Fig. 5.—Mediæval Mug, Half Restored

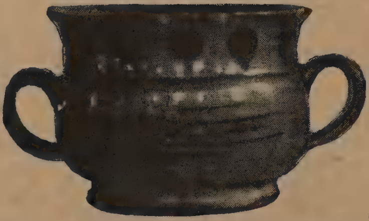


Fig. 6.—Mediæval Mug, Half Restored

Another good, but expensive, filling material may be made from oxide of zinc combined with syrupy phosphoric acid. The zinc powder should be mixed on a slab by means of a spatula, and the resulting mass forced into the mould. The composition hardens very quickly, and after a short time sets like stone. It is altogether the finest material for work of this character. Kaolin clay worked up with fish-glue has also been used for porcelain with good results; also for soft earthenware, powdered glass combined with the same material, and also with white of egg, has given satisfaction. The latter, however, whilst being apparently subject to no shrinkage on drying, is not very strongly cohesive.

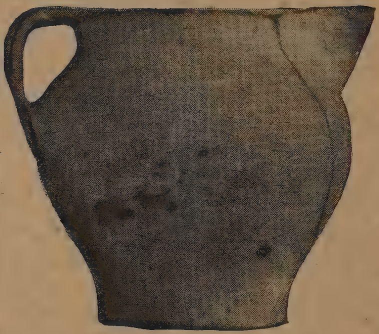


Fig. 7.—Mediæval Mug, Half Restored

The composition known as "gilders' cement," which will be described later, although largely used for other branches of restoring, is not suitable in the present instance, as it must be used whilst still warm, and this would necessitate the employment of a mould of either plaster or gutta-percha.

When using the materials already described, the work should be put aside for twenty-four hours. At the end of that time the wax may be removed by heat, the result being that the model remains an exact replica of the original. Colouring should not be performed until some weeks afterwards.

It is obvious that only one surface is faithfully copied in this way; but it is seldom that more than this is required. The back of the counterfeit fragment, however, may be rubbed down if necessary with glasspaper, to the level of the rest of the specimen, and should it become loose during the process it may be fixed again with zinc white.

Two examples of specimens restored in this way are shown by Figs. 3 and 4, the first, a salt-glaze plate, having a considerable portion of the rim restored, and the second a somewhat less ornate example by Lakin and Poole, in which seven bars of the border were made up in the margin.

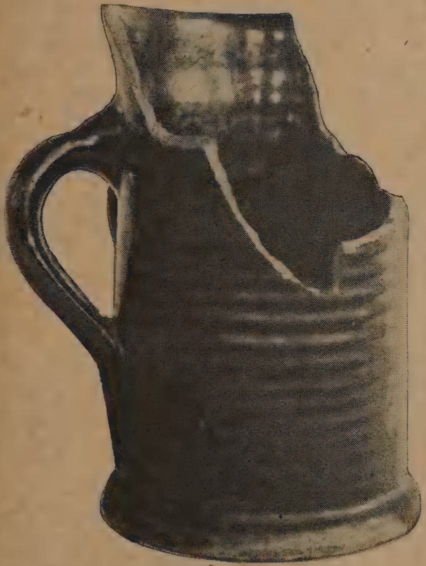


Fig. 8.—Mediæval Mug before Restoring

Building-up Missing Parts.—Passing now to a consideration of methods of restoring in which there is no possibility of utilising a mould, notice may be given to the three specimens of mediæval earthenware shown by Figs. 5 to 7. It may be mentioned that in most museums and other places where early pottery of this description is to be seen, it is a generally accepted rule that restoration may be performed where sufficient of the original remains to give a clear indication of the whole "expression" and form. Nothing should be conjectural in the counterfeit portion; but it is permissible to model it on the lines of an almost similar example. The three specimens just referred to were all more or less in the condition of the one shown in its original state by Fig. 8.

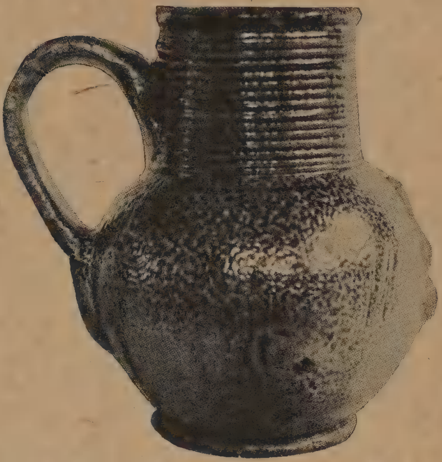


Fig. 9.—Fulham Stoneware Jug with Handle Restored

The method adopted was as follows: Several sheets of thick brown paper were cut to convenient size, wetted, and attached by means of paste across the gap on the inside, in such a way that the circular condition of the interior was restored. Several thicknesses of paper were used, until a good substance resulted. The specimen was then put aside until the paste completely hardened. The filling in this case was gilders' cement, which is made by boiling 7 lb. of glue in 3½ pt. of water, melting 3 lb. of resin in 3 pt. of raw linseed oil, next mixing the two in an iron pot, and allowing to simmer gently for about half an hour, and finally pouring the mixture into a quantity of finely sifted whiting, and kneading into a mass the consistency of dough. If a large quantity of the material is made at once, it can be rolled out into cakes of convenient size, and allowed to harden. Such hardened cakes, however, require steaming in a covered pot on a piece of canvas stretched across the interior. When in a thoroughly malleable condition the composition may be laid in a more or less regular layer on the paper backing, which has been previously oiled. Then by the use of a cylindrical rolling pin or a photographer's squeegee roller, the surface may be rendered comparatively smooth, and the substance equal to that of the rest of the original vessel. The rim should then be reduced with a knife, and any superficial modelling carried out roughly. In this condition the specimen may be put aside until the composition has completely hardened. The backing can then be removed, and the surface worked up with a rasp and glasspaper. On the care and precision with which this is performed largely depends the success of the restoration.

In Fig. 8 it will be seen that regular raised bands occur throughout the greater portion of the height. These were counterfeited by the careful use of glasspaper, the specimen having being fixed on a turn-table and rotated from side to side. The reproduction of a missing handle in composition is a comparatively simple matter, the knife and glasspaper being employed on a suitably formed mass surrounding a central wire. Fig. 9 shows a Fulham stoneware jug, of the time of William III., that has been restored in this way.

Restoring limbs, drapery, etc., to imperfect porcelain and other figures is essentially the highest point to which the skilful restorer may attain. It must not be supposed, however, that the execution of work of this character demands always the same degree of skill. Both of the examples illustrated by Figs. 10 and 11 are technically good, but they demanded individual and different treatment.

Decoration.—The decoration of restored areas requires in many cases extremely skilful brushwork. Where a complementary portion of the original specimen remains, however, practically perfect outline of detail may be obtained by the use of tracing paper and carbon sheet. If plaster-of-paris has been the material employed, it must be prepared to receive colour beforehand by saturation with paraffin wax. Artists' tube colours should always be used for painting, and wherever possible gold-leaf for broad tracts of gilt instead of gold bronze paint. Spirit varnish diluted with an even quantity of spirit should finally be used after the colour has completely dried. Several coats in certain cases may be applied, until an apparent suitable thickness of glaze has been counterfeited. A neat finish should be made some little distance on to the surface of the original. The specimens illustrated by Figs. 1 to 11 were, at the time of photographing, in the collections of Messrs. W. J. Pavyer and G. E. Bullen.

REPAIRING UTILITY CHINA AND GLASS

In mending china which, after repair, has to serve a useful purpose, it is questionable whether anything short of rivets should be used, because cemented utensils are always more or less in danger of falling to pieces with ordinary usage.

Cements.—Several good cements can be made. The combination of shellac and rectified spirit known as chinese cement is a very strong medium, and is made by dissolving $\frac{1}{4}$ lb. of the best pale orange shellac in 3 oz. of strong spirit. The shellac should be pounded up fine, and placed in a stoppered or corked bottle with the spirit, in a warm place, and the mixture should not be used until the shellac has become thoroughly dissolved.

The real chinese cement, however, as made by Chinamen, is produced by pounding glass to a very fine powder, then sieving it through silk, and afterwards mixing and grinding it with albumen. Ornaments repaired with this medium (providing heat is not applied) will not readily separate at the joint.

White-lead will resist boiling water, and make an exceptionally strong repair, if it is allowed to set before the article is brought into use; but it will take several weeks to harden properly. It is difficult to remove when allowed to harden on an exposed part. Flake-white (see p. 50) is a fine variety of white-lead.

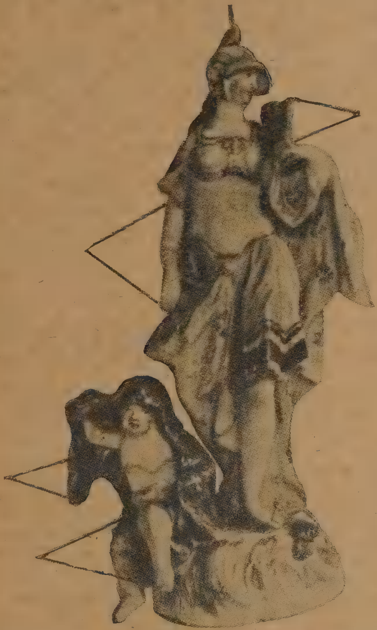


Fig. 10.—Dresden Statuette with Parts Restored as Indicated

For ornaments, a cement made by dissolving isinglass in acetic acid is very suitable; but this will not stand hot water. It should be evenly applied to the broken edges with a camel-hair brush, and sets hard in twelve or fourteen hours.

A good waterproof cement for glass consists of 3 parts of plaster-of-paris, 3 parts of litharge, 3 parts of white-lead, and 1 part of powdered resin, all by measure. When required for use, mix it into a paste (the proper consistency depends on the purpose for which it is required) with boiled linseed oil. It sets hard in three days. To colour a cement, mix with it colouring matter to be purchased at any oil or colour stores.

Winchell's cement is given as a universal cement. Procure ½ oz. of white sugar, 1½ oz. of fine starch, and 2 oz. of clear gum arabic. Crush the gum to a powder, then dissolve it in the quantity of water that would be used in laundry work for the quantity of starch mentioned, and afterwards dissolve both the starch and the sugar in the gum solution. Next place this mixture in some suitable receptacle, and put the latter in a saucepan of boiling water, leaving it thus until the starch becomes clear. The cement will then be ready for use, and should be of about the consistency of tar. If it is to be kept for some time, a few drops of oil of cloves or sassafras will prevent it becoming unfit for use.

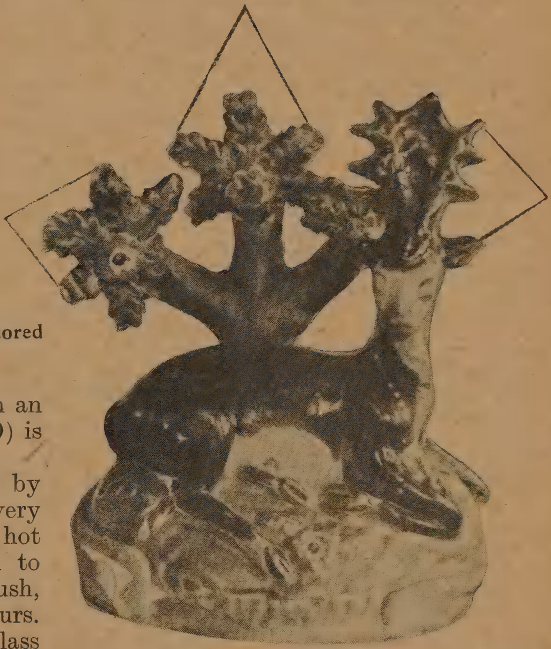


Fig. 11.—Staffordshire Figure (by Salt) with Parts Restored as Indicated

Using Cement.—It is the way in which the cement is used, rather than the kind of cement employed, that is the important element in making a strong joint. The parts should be heated in the oven, as the cement begins to harden immediately it comes into contact with cold materials, and therefore produces a "set" layer between the broken parts. If possible, the article joined should be bound tightly with tape until properly set, and should be placed in some cool apartment where it is not likely to be shaken or upset. Always undertake the repair as soon as possible after the article is broken, as then the edges are not in any way damaged, and a close joint results. Shellac alone makes an extremely strong joint if the broken parts are sufficiently heated to fuse it when applied; but it leaves a very noticeable dark line on white china.

Water-glass Cements.—These are of great value in repairing glass, china, etc., and with all of them it is important first to heat the article to 212° F. (the boiling point of water), and then apply the water glass, previously liquefied by heating, with a warm brush to the surfaces that are to be cemented. The latter must be pressed closely together, or if necessary held in position by a cord tied round them. After drying for twelve to fourteen days at a moderate temperature the cement will be quite hard. For stone, glass, and porcelain a very hard-drying cement can be obtained from manganese, zinc white, and water-glass solution, another being made by mixing powdered asbestos and soda-water-glass solution. The articles to be cemented should be moistened before applying the cement with liquid water-glass, and any cracks appearing during drying filled up with some of the cement slightly diluted. A good cement for glass and porcelain can also be prepared from 1 part of very finely ground and washed fluorspar and ½ part of finely powdered glass with ½ part of soda-water-glass solution of 36° Beaumé, these substances being mixed to a rather thickish mass. A thin layer of the mass must be rapidly applied to the surface to be united, and the parts pressed together. In a few days the cement will have become very hard.

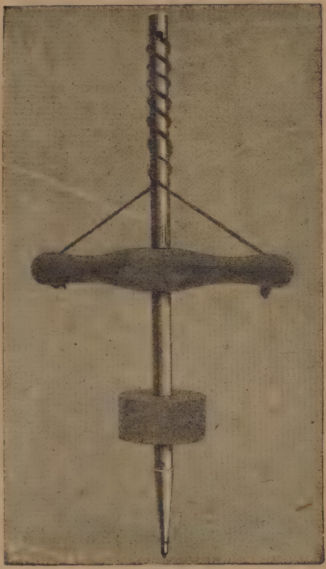


Fig. 12

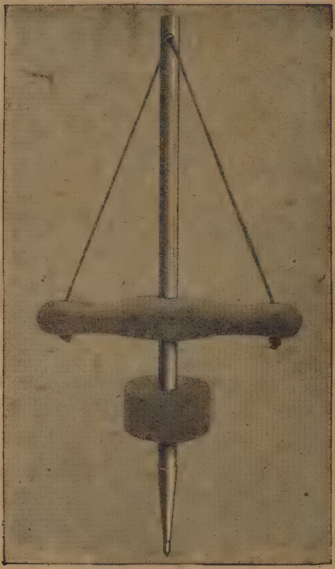


Fig. 13

Figs. 12 and 13.—The China-riveter's Drill

Riveter's Tools.—Riveting is the most substantial way of repairing broken china, but entails a small outlay for the drill, hammer, wire-cutting pliers, file, and material for the rivets.

The drill complete is shown by Figs. 12

and 13. A steel spindle, 14 in. long, pointed at one end, will be required; a hole must be drilled through its head to take the tape, which is fastened to the ends of the wooden arm. This arm is bored (see Fig. 14) so that it can easily pass up and down the spindle. A piece of box or ebony should be turned 2¼ in. in diameter by 1 in. thick, as shown, and a hole slightly smaller than the steel rod drilled through it, afterwards hammering the block tightly into position. This hole must be drilled accurately, or the drill will wobble, and it is, therefore, desirable to drill the hole half-way through from each side. A still better method is to knock the wood on the spindle, and then true it up in a lathe. The drill bits (Fig. 15) consist of tapering tin tubes with a diamond point cemented or soldered in one end. These tin tubes fit tightly over the cone end of the drill proper, but it is not an easy matter to set the diamond fragments or "sparks," in the tubes. The mouth of the tube should be not more than $\frac{3}{32}$ in. in diameter, and should not begin to widen out into a cone at less than ½ in. from the end.

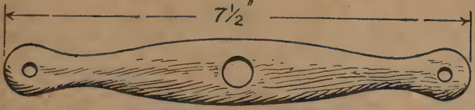


Fig 14.—Drill Finger-piece

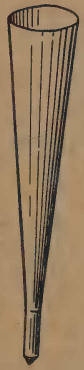


Fig. 15 — Diamond Bit

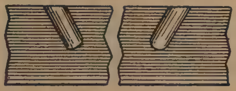


Fig. 16.—Section showing Position of Rivet Holes in China

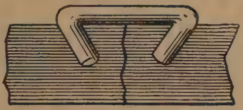


Fig. 17.—Rivet in Position

Well tapered steel drills can be used with fine diamond powder moistened with oil as an abrasive; but neat holes are rarely produced in this way, and the surrounding glaze is frequently chipped off.

Using the Drill.—The method of using the diamond drill is as follows: The spindle is twisted so that the tape winds itself round the stem, as shown in Fig. 12. When the arm is pressed downwards, the tape unwinds and causes the spindle to revolve (see Fig. 13); then, if the hand is raised again at the crucial moment, the tape will immediately coil round the stem in the opposite direction, and thus be ready for another downward thrust of the arm. A little practice will soon enable the beginner to get a continuous motion. The operator sits, and always works the apparatus with the right hand only, leaving the left hand free to hold the glass or china rigidly against the thigh of the left leg. Before using the drill, always dip the point in oil, and bore all holes in the articles about ¼ in. from the edge, at an angle so that they incline slightly towards the breakage (see Fig. 16). The positions at

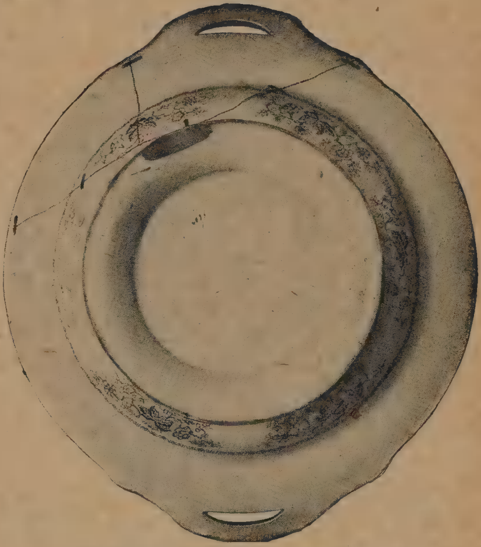


Fig. 18.—Back of Riveted Plate

which the holes are to be drilled should be very accurately marked, and care should be taken not to bore the holes straight through the material. If the finger is held underneath the part which is being drilled, the warmth will indicate how far the bit is through the china.

The clasps or rivets generally consist of $\frac{1}{16}$-in. brass wire, with one side half filed away, so that a flat surface meets the china. Of course, the thickness of the wire employed depends on the character of the article to be repaired. In the case of plates and similar goods, always fix the rivets on the back, as then they cannot be seen. Fig. 17 shows the rivet in position after the repair is accomplished, and Figs. 18 and 19 are photographic illustrations of riveted plates, and indicate how the rivets should be distributed.

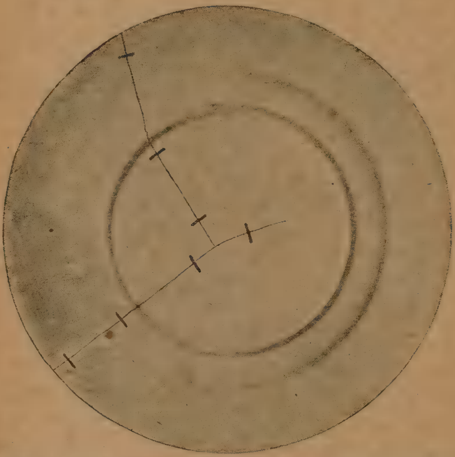


Fig. 19.—Back of Plate, showing Riveting of V-piece

Making Rivets.—To make the rivets, first place one end of the filed wire in the mouth of a pair of suitable pliers and, on the nose of the tool, hammer the wire down a little past a right angle with the flat side (see Fig. 20). Then carefully measure where the second bend should be, cut off the surplus wire, and bend down the second end to make the shape shown in Fig. 21. Each rivet should fit the hole so tightly as to require gentle knocking into position with a very light hammer, or it should spring into position if given a pull with the pliers. Take care that the turned-down ends are not too long, as if this is the case, the rivet will not lie flat on the broken article. To complete the repair it is then only necessary to fill up the holes and cracks with plaster-of-paris mixed with water to the consistency of cream, and either left white or coloured according to the articles being mended.

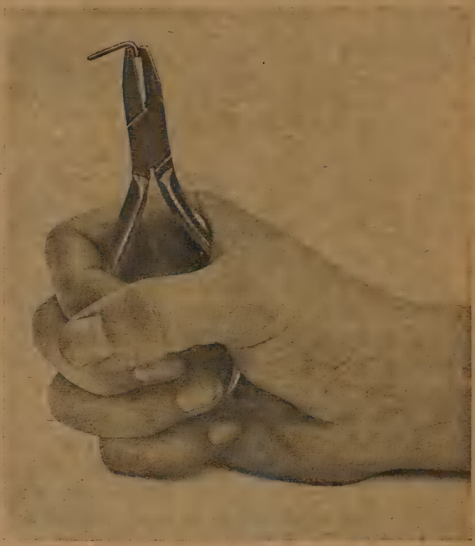


Fig. 20.—Bending of Rivet

Typical Riveted Repairs.—The arrangement of rivets for a plate from which a V-piece has been broken out and which is badly cracked as well is shown by Fig. 19.

Cement would effectively repair a jug broken in the body part as shown in Fig. 23, but rivets make a still stronger job, and they should be distributed as indicated. A bottle repair is shown in Fig. 25.

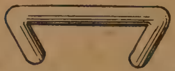


Fig. 21.—Finished Rivet

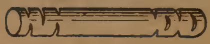


Fig. 22.—Notched Dowel

If jugs are valuable and are used only as ornaments, cement may prove satisfactory for attaching handles, as the disfiguring effect of rivets is then avoided; but if the jugs have to be used and the breakages allow such a plan to be adopted, fine wire rivets should be employed to strengthen the joints. When a thick handle is broken, china repairers often employ hidden wires (not more than $\frac{1}{2}$ in. long) to strengthen the joint. A hole, somewhat larger in diameter than the wire, is carefully drilled in each piece of the handle, and the wire, after having its ends roughly notched with a file, is fixed in position (see Fig. 23) with a very little plaster-of-paris, which is placed in the holes before the wire; if too much were used, some of the plaster would be forced out of the holes by the wire, and would prevent a close join being made. The faces of the broken parts are also thinly smeared with suitable cement just before bringing the parts together. The roughened wire dowel is shown by Fig. 22.

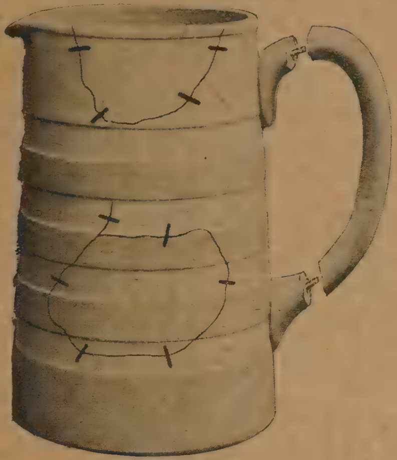


Fig. 23.—Repaired Jug

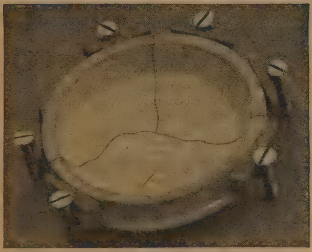


Fig. 24.—Teapot Stand Clamped Up

When a large Bohemian glass vase is broken in the stem, obtain a ferrule a trifle larger than the raised part of the glass stem; the ferrule may be of brass, or plated metal, or silver. The cement may be made by melting together 5 parts of resin and 1 part of beeswax, and stirring in 1 part of venetian red or yellow ochre. The glass stem should be warmed and coated with the cement; the ferrule should be warmed and coated internally; then the parts should be again warmed and pressed together.

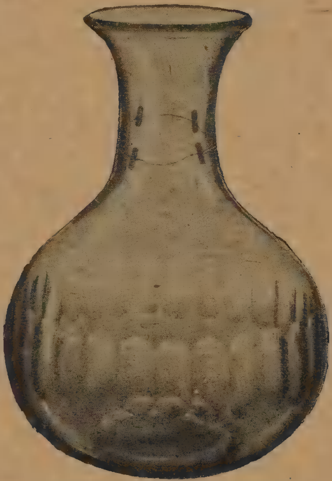
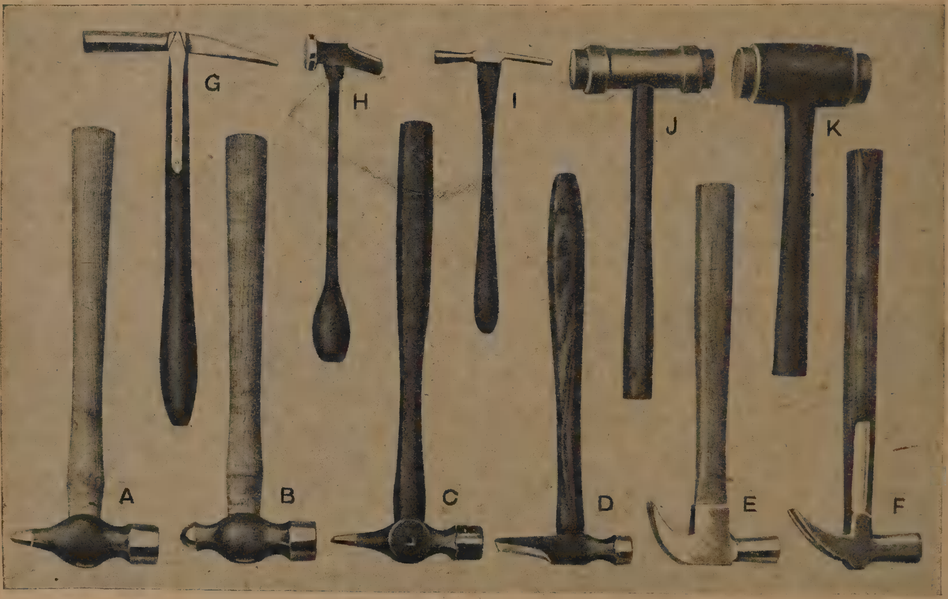


Fig. 25.—Riveted Bottle

Repairing Broken Teapot Stand.—Fig. 24 shows a method of clamping together the parts of a teapot stand so as to obtain a fine and almost invisible joint. A piece of wood 1 in. or 2 in. wider than the stand is obtained and the stand loosely fitted together upon it. A pencil line is then drawn round the stand on the wood, and the ends of the fractures indicated on the wood. Screws are then inserted at suitable positions an inch or so from the line, and so spaced as not to come opposite a break. The broken stand is next placed in position with the cement ready applied to the fractured edges, and thin wooden wedges are inserted between the screws and the stand, so as to apply gentle pressure. The operation requires great care to be successful. If the stand is recessed on the under side, it is wise to strengthen the cemented joints with rivets.

Various Hammers and Their Uses

Engineers' hammers are illustrated by A and B herewith, the former showing the cross-pene and the latter the ball-pene pattern. Carpenters' hammers are of the Warrington pattern C, or of the Exeter or London pattern D; but the handyman may prefer the claw hammer of the adze-eye pattern E, or of the Canterbury pattern F. Upholsterers use a hammer of the shape shown by G, this resembling in pattern, but not in weight, the watch and clock-maker's hammer I. The metal repoussé worker's hammer is shown by H. For heavy metal work, where bruising must be avoided, rawhide hammers, J and K, or lead-faced hammers are used.



Fitting-up a Workshop for Motor and General Repairs

THIS chapter will discuss the equipment of a workshop intended chiefly for metal-working and amateur engineering, and will be especially helpful to those who possess a motor-car or motor-cycle, and wish to do the majority of the repairs themselves.

Situation.—The best place for the workshop is undoubtedly the shed or coachhouse in which the motor (car or cycle) is kept. Therefore, if possible, when planning the shed, sufficient room should be allowed for the accommodation of the work-bench, lathe and brazing hearth, which are essential for the most simple repairs, though not necessary for adjustments, which can be done with the tools carried on the car. If it is not convenient to have the bench, lathe, etc., near the car, it is advisable to rig up a shop within easy reach of the motor-house.

The Lathe.—A good lathe is by far the most necessary tool, and will come in for a great deal of use. A lathe that can be highly recommended for this type of work is the Drummond 3½-in. centre screw-cutting and boring lathe, complete, with Cushman's scroll chuck, etc. With such a lathe, practically any job can be undertaken if the amateur mechanic has sufficient skill; but a screw-cutting lathe is not an essential, although a slide-rest is, as it is almost impossible to work with sufficient accuracy with a hand-rest only. A lot of jobs can also be done on a wood-turning lathe, such as truing up valves, removing scale and pitmarks from their faces, rubbing down stems, re-facing pulley grooves, re-turning fibre rings for wipe contacts, polishing and, in fact, anything of a light description. Heavy work, such as making new bushes, would be too much for the average worker not possessed of a slide-rest. A good chuck is essential, for nothing is more annoying than having the work thrown out when nearly completed, as it can rarely be re-chucked true (unless running between centres, of course), and it often gets spoiled by the tool as it comes out of the chuck. A slide-rest can be fitted to a good make of lathe (plain) for about £8 new, and from about 30s. second-hand, and this will, no doubt, be preferred by many to purchasing a new lathe. Sometimes, when an old lathe seems worn out, it only requires new bushes fitted to the mandrel.

The lathe should face a window, so that the tool does not cast a shadow on the work, and the light should be good. High speed will not do for metal work, and the gearing usually employed in wood-turning will give too great a speed and must be reduced. A smaller pulley, for fixing to the large driving-wheel of foot-power lathes, if none small enough is available, can be made of wood. The ends of a barrel, screwed together so that the grain of one-half crosses the grain of the other at right angles, will be found to answer very well, if the wood has not warped. The whole can be fixed to the driving-wheel with screws passing through into holes tapped in the spokes; or it can be clamped by means of ordinary carriage bolts passing through the spaces between the spokes, and held there by iron plates (or finger washers) pressed tightly against the spokes by nuts on the bolts. This plan can also be adopted for enlarging the driving-wheel of a lathe, thereby making it fit for wood-turning. For instructions on metal turning, see other chapters.

The Bench.—This should be placed in a good light, and be as large as possible, a good size being 6 ft. long by 2½ ft. broad by 3 ft. high. The top should be formed, preferably, of oak planks 1 in. thick. It is well to have a shelf running from end to end the full width of the bench, attached to the legs, of which there should be six. This shelf should be midway between the top of the bench and the floor, and will be found useful for holding odds and ends and many of the tools which are in constant use—hammers, copper-headed and wooden-headed mallets, cold chisels, scrapers, oilstone, hacksaw blades in box, screw taps in box, drills, files, etc. A rail at the back and running the whole length of the bench about 1 in. from the edge, blocked at intervals, and fixed with long French nails passing through the blocks, will be useful for holding files and saws. A quick-acting vice at one end, and an ordinary smith's screw vice at the other, will be best, as the quick-acting vice enables two heated parts to be quickly gripped together for soldering, if this vice is adjacent to the stove for heating the soldering bit. Under the shelf of the bench one or two large boxes, in which can be kept various odds and ends of wood and metal, such as blocks of wood for holding behind work being bored, iron plate, tin-plate, sheet brass, copper, brass and iron piping, various sizes of bar iron, etc., will be very handy.

If gas is available, have a bracket immediately over the centre of the bench, high enough to prevent its getting knocked, and fitted with an inverted incandescent burner. A similar bracket should be fixed over the centre of the lathe. The gas bracket above the bench should be fitted with two nozzles and cocks below the burner, one to carry the gas through a length of flexible tube to the copper-bit heating stove, the other to the brazing hearth. The heating stove should accommodate two bits. One iron should be larger than the other, and the copper bit should be adjustable so that it may be turned at any angle to the iron shank and handle.

Making a Brazing Hearth.—The brazing hearth can be cheaply made, the necessary materials consisting of two bellows, some lead piping, and an old packing-case to support a large size frying-pan—about 1 ft. 4 in. by 1 ft. The bellows are fixed one above the other, interconnected by a fixed lead pipe, one pair of bellows worked by the foot pumping air into the pair above it, from which the air is taken to a Bunsen blast burner by flexible tube. This Bunsen burner can also be easily and cheaply made, and as this works very well and will be found useful for both soldering and brazing, the following hints on making it are given. First, get two ordinary large house bellows about 1 ft. square, or larger if possible; the larger the better. Next a good strong packing-case about 2 ft. long by 1 ft. 3 in. high and 10 in. wide is required. One end of the box will form the base, and to make it steadier, two 1-in. boards should be screwed across to protrude about 6 in. on each side, the front one being considerably wider, as can be seen at T (Fig. 1), which shows the apparatus with one of the case sides removed. The packing-case proper is denoted by the letter A; the part A S A was formerly the bottom of the case, but is now the back; and the top A V A was the end of the packing-case. Half-way between the top and bottom a shelf B should be fixed, having a large hole cut out of the middle at G to accommodate the union piece (seen in section), which holds the lead air-pipe communicating from the lower bellows to the upper.

In the back, near the bottom, at S, cut a hole for the nozzle of one of the bellows, and above the shelf cut another hole at S′ to take the nozzle of the other bellows.

The bottom bellows C should have the top handle extended by a piece of stout bent iron N to act as a pedal, and should be screwed to the base. A central hole about 3 in. in diameter should be cut at P to allow the air to reach the valve. Now get a piece of lead pipe ½ in. inside diameter, and, having cut down the nozzle to just under that diameter, force the mouth of the pipe over it as at S, and bend the pipe F as shown, to reach the centre of the shelf B and enter the hole G until flush with the top. Remove the lead pipe and get a block of wood about 3 in. square. Cut off the corners and bore a hole in the middle, so that the lead pipe will just pass through it, and countersink the hole. Broach out the mouth of the lead pipe until it becomes bell-shaped and fits the block of wood, so that its edge is flush with the wood when pressed hard against it. This is clearly shown at G, where the dark shading represents the wood block. Cut a leather washer the size of the block, with a ½-in. central hole, and lay this over the hole in the bottom of the top bellows where the leather flap valve is. Bore two holes in the wood block, and screw this down tightly to the bottom of the bellows, so that the bell-mouth of the lead pipe faces the hole and has the leather between it and the block. This should make an air-tight joint for the fixing of the pipe to the bellows.

Next, push the nozzle of the bellows through the hole S′, and screw the bellows down tightly to the shelf B. Join the lead pipe to the nozzle of the bottom bellows, and make an air-tight joint with glue and tape bound round. Between the top of the upper bellows D and the top of the packing-case at V, a stout sofa spring E is fixed to keep the top bellows shut down tight till air is pumped in from the bellows below.

From a screw near the top of the case stretch a house-bell coil spring M, and attach its lower end to the foot-plate or pedal N. This spring tends to keep the lower bellows open. When pressure is put on the foot-plate N, air is pumped from the lower to the upper bellows, and thence along the flexible pipe R to the Bunsen blast nozzle which is described in detail below. If it were not for the upper bellows, the air would come to the nozzle in puffs, but the spring E keeps the pressure constant, and a steady blast is secured. The rubber pipe R should be of sufficient length to reach the hand conveniently, and allow room for movement.

The hearth K can be made from sheet-metal, with the edges bent upwards to form a tray; or an old frying-pan will answer very well. Whichever is employed, four iron stays or legs H must be used to raise it above the top of the packing-case as shown. These legs should be screwed at one end to the sides of the case, and at the other to the pan, and if a frying-pan is used, the handle may be cut and bent to form a hook as at L; it then acts as a support for the blast nozzle.

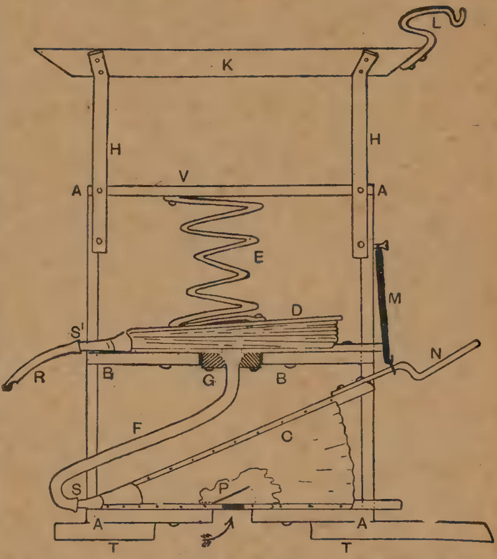


Fig. 1.—A Home-made Brazing Hearth

For use with the brazing hearth, a blast gas nozzle on the Bunsen principle is required, and this is easily made from two pieces of gas-piping, a right-angle joint, and two mouthpieces to take flexible pipes. First, get 1 ft. of ¾-in. brass (or iron) pipe and an elbow, internally threaded at both ends. Cut 2 in. off the brass pipe, and cut a thread at one end of the short piece and one end of the long piece, to screw into the elbow as shown in Fig. 2. At the other end of the long tube solder in a cock or mouthpiece to take a large diameter flexible pipe from the gas bracket. Next get 1 ft. of $\frac{1}{4}$-in. brass pipe, and bend it to the shape shown at B, soldering a mouthpiece at F to take the smaller diameter air-pipe R (Fig. 1) from the bellows. Bore a hole through the elbow C, and push the pipe in, making a tight fit, and so that it passes centrally through the larger brass tube until it nearly reaches the end as shown at D. Run a shoulder of solder to hold the small tube firmly in the larger one as at E, and unite with a drop of solder the large tube A and the small tube B where they cross at G.

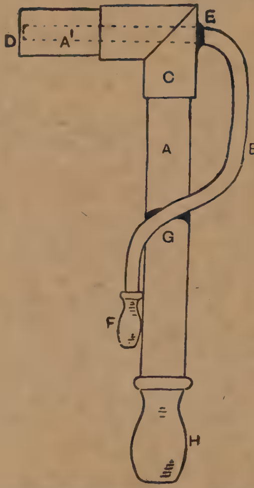


Fig. 2.—Blast Gas Nozzle for Brazing Hearth

The gas passes up the large pipe and out at D, and a blast of air is forced through the centre of the flame through the small pipe B. The shape of the small pipe allows of it being readily hung up on the hook L (Fig. 1) when not in use. Instead of the mouthpiece shown at H (Fig. 2), a cock will be found more convenient; but it should not be too small, or it will restrict the flow of gas, which should be as great as possible. No gas-cock should have less than $\frac{1}{4}$-in. hole.

The fuel for the hearth consists of chunks or cubes of asbestos, and when these are blown upon with the gas flame, the heat is quite sufficient for moderately heavy brazing. Be careful not to get any kinks in the flexible tubes, or the air and gas will be reduced in quantity, if not stopped altogether.

A square of thick asbestos (sheet) is useful for laying on small articles whilst brazing or hard soldering, and a piece or two of charcoal will be handy for silver soldering.

Screws and Screwing.—A good set of stocks and dies will be found useful. Such tools will get but little use in the hands of the average worker, so that two die-plates and taps ranging from $\frac{1}{2}$ in. downwards to $\frac{1}{16}$ in. Whitworth threads will be sufficient; though, for building a motor-cycle or any similar big work, a good set of stocks and dies (taper and plug) would be an essential, because starting a screw in a die-plate means that the rod on which it is cut must taper to get a bite, and this is not feasible unless the rod or pipe is sufficiently long to allow of this taper.

Useful iron screws with back nuts can be purchased from most ironmongers for a few pence a doz., ranging from $\frac{1}{8}$ in. diameter $\frac{1}{2}$ in. long to $\frac{1}{4}$ in. diameter 2 in. long, with round or countersunk heads. The smaller screws will be found useful for replacing lost carburettor screws, and if one screw is filed with flats on it to leave three cutting edges and tapered, it will cut a thread for itself in the aluminium, when another screw, uncut, can be put in its place. This chiefly applies to French carburettors which have French threads to the screws, and are, consequently, difficult to replace. It is always advisable to have a selection of these screws and square nuts.

When screwing two pieces of metal together, always be careful not to cross-thread, and if the joint is not required to be loosened at any time, burr over the end of the thread. Always run a little paraffin round the thread before screwing home, as this prevents seizing or binding, and a little powdered resin sprinkled on will ensure a tight grip.

In boring holes for screws, remember

that they must be smaller than the screws, and only just large enough to allow the tip of the tap to enter and get a bite. The best way of ensuring this is to work the screw in the die-plate first, mark the hole, and bore a hole equal in diameter to this. The whole subject of cutting screw threads in metal is dealt with fully elsewhere in this work.

Riveting.—For riveting light work, bifurcated rivets are about the easiest to fit; next copper rivets, and then iron rivets. Holes the exact size of the rivets should be drilled, the rivet inserted and cut off to the required length, so that about $\frac{1}{8}$ in. protrudes. A riveting punch having a bell mouth should be used, to ensure the riveted-over portion having a round head like the one on the other side. The hammer should be used first, but only round the edges of the rivet so as to spread it, but not to flatten the top centre. Then the punch should be used to finish off. Rivets can be bought in all sizes and lengths from $\frac{1}{8}$ in. upwards. For riveting leather to metal, hollow rivets are best. When using copper rivets it is well to insert a copper washer to form a larger head, as copper rivets are flat-headed and do not require punching.

Drills.—Drills are rather expensive tools, and taper reamers will be suitable to take the place of a set of drills of large diameter. It is well to get a selection of flat drills from the smallest made up to $\frac{1}{4}$ in. Also have three twist drills—$\frac{1}{8}$ in., $\frac{5}{16}$ in., and $\frac{1}{4}$ in.—a $\frac{3}{8}$-in. and a $\frac{1}{2}$-in. flat drill; and any hole required between these or larger reamer out with a square taper reamer, which cuts quite quickly if used with a brace. As a reamer cuts a taper hole, care must be taken not to bore the hole too large, and it should be tried now and then to see that the screw or rivet to be passed through will only just enter. Then the work should be reversed, and the boring continued from the other side. A lathe is useful for boring purposes, and to avoid removing work already chucked, use a small American drill chuck, which is not dear and answers very well.

Very good drills can be made from knitting needles by softening and flattening out one end, and grinding to the right angle and hardening again to straw colour. Always lubricate well when drilling, and do not turn too fast; when the drill shrieks it is not cutting. It should be remembered that the thinner the points the easier the drills will begin to work. Small drills are best tempered by heating and then plunging into a tallow candle. See elsewhere in this work for a detailed treatment of the subject of drilling metal.

Files.—A good stock of files of all shapes and sizes, both coarse and fine cut, is necessary. When any of these cease to cut, they should not be thrown away, as good lathe tools can be made from them. Get three rough, three middle, two bastard, two second-cut, one smooth, and one dead-smooth files; one horse, one bastard, and one smooth rasp; a collection of small clockmaker's files of various shapes; five round coarse-cut files of varying sizes; four half-round coarse-cut files (one second cut); and three square files, all bastard, of various sizes. With such an outfit most motor-repair jobs can be done. Another chapter in this work discusses the subject of files and filing.

One of the most useful tools to have is a hack-saw for cutting metal. The saw-blades cost a few pence each, and fit into a separate frame, which can be tensioned up. For steel cutting, saws with fine teeth should be obtained, whereas for cutting brass coarse teeth will be found to answer best. Never cut a tube in half with a hack-saw, or the teeth will be broken off; always use a file. If the tube is thick the saw can be used, provided it is not allowed to cut right through the metal, but is stopped when nearly through, when the tube can often be broken. The coarser the saw-teeth the quicker the work, even with steel; but the shorter the life of a saw-blade. Never give a twisting motion to a hack-saw, or the teeth will quickly chip off. This is not easy to avoid, and comes only with practice, as does the art of filing. Hack-saws are described and illustrated in another chapter.

A fret-saw and a packet of fine-cut blades are often useful for cutting round difficult corners in light work; the blades for cutting wood are quite useless.

Odd Tools.—Other necessary tools are two pairs of callipers, inside and outside; a pair of compasses; a steel foot rule; a bell centre-punch, and one or two other punches; a pair of strong lever wire-cutters; a pair of large metal shears; a hand vice; two pairs of ordinary pincers; and one pair of round-nose and one pair of flat-nose pliers; a metal T–square; two or three various sized hammers; a copper and a wood mallet; a glass-cutter's diamond; a pipe wrench of large size; and two or three screwdrivers. A metal scraper will be handy, and one can be made from sheet steel; part of an old joiner's T–square does well. A portable hand drill, with chuck to take up to ¼-in. drills, will be very useful, and should have a chest pad and two handles, one to hold by and the other to work the drill.

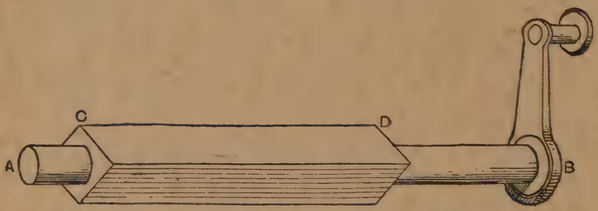


Fig. 3.—Handle and Axle for Grindstone

Grindstones.—Cutting tools much in use will require re-sharpening, and for this purpose a grindstone about 1 ft. in diameter and 4 in. thick, worked by the foot, will be found preferable to an emery wheel. It can be rigged in a wooden trough and run on roller bearings made of old wooden roller-skate wheels. The axle ends with a crank, a connecting rod from which depends to a pedal board. If the grindstone is obtained without an axle, one should be made of square-section iron, the square being turned off circular about 1 in. beyond each side of the wheel. One end A should have this circular axle about 1 in. long, whilst the other end B should be about 3 in.; see Fig. 3, where A B is the square-section iron bar turned down at the parts A C and D B respectively.

The grindstone will have a square hole in its centre for the axle, which may be fastened in tightly by running in lead. To do this, cut a square hole in a sheet of flat tin and lay on a flattened earth surface. Then drive the axle through the hole in the tin into the earth, so that it stands up perfectly straight and exactly at right angles to the wheel. When this is slipped over it, see that the axle is as central as possible. Then melt some lead in an old saucepan or ladle, and pour this round the axle, filling up the space between it and the stone. When cool, the axle will be found a tight fit in the stone.

Next make the trough of ½-in. wood, and paint the inside with boiling pitch to make it water-tight. In the centre (top) of each side make a groove and rest the axle in this. Then procure four old plain boxwood roller-skate wheels which run true, and, with four long screws the size of the centre holes in these wheels, fasten them to the trough sides, two on each side, so that their peripheries just escape touching exactly beneath where the axle rests. Remove the stone and enlarge the groove where the axle rested, so that it revolves on the rollers. Support the trough on four legs so that it stands firmly about 2 ft. from the ground. Rivet a crank arm with a throw of about 2½ in. on to the end of the axle, and hang from this an iron rod hooked at both ends, at the top to the crank arm and at the bottom to a footboard, or pedal-hinged to one of the legs.

Such a grindstone can be set up cheaply, and has the advantage of being capable of instant removal from the trough. When first set up it will possibly not run true, and will require grinding down. An old plane iron, or worn-out file, or a piece of iron gas-pipe, will do for this, and it is best done dry, otherwise the stone should always be kept wet when grinding, or it will soon get worn into grooves and spoiled.

Receptacles of Various Kinds.—A good way of keeping small screws, nuts, split pins, red-lead, etc., is in wide-mouthed glass bottles, so that they are easily seen. Red-lead should be kept mixed in the form of a paint, with a film of linseed oil on the surface. Then when it is required for use this film can be broken and as much paint fished out with a piece of wood or tin as is required. The film of oil will keep the paint in workable condition for some time.

Small drills are best kept in a tin box, large enough to prevent them being packed one above the other, so that they can be selected without turning out the whole collection. Large drills should be kept in holes bored in a thick piece of wood, each drill in the hole bored by itself. Drills should be kept oiled and free from dust. Rust should be kept from all tools by means of a coating of linseed oil. Burnishers should be kept well oiled and wrapped in rags. Screwing taps should also be kept in holes bored in a thick piece of wood with the size marked plainly in front of the hole; they should also be kept greased.

Old biscuit tins (not round) make very good boxes for keeping oddments, such as pieces of house-water cocks, old gas fittings, pipe unions, etc., which will come in most useful for making contrivances. These boxes should be clearly labelled, showing at once what type of oddments they contain. One box should contain brass gas fittings; another, brass and copper pipes; another, old tyre valves, security bolts, horn fittings; another, pieces of Bowden clips and fittings, old plugs, and so on. If possible, have a fair-sized old chest of drawers, which will be invaluable for keeping the shop tidy.

Various Practical Matters.—Do not keep whole lengths of gut driving-bands for the different lathe speeds; but take the shortest (slowest speed), and have short additional lengths fitted with hooks and eyes to make up to the longest required.

Always keep the lathe-bed clean, or chips may easily throw the back-centre out of line. Also after removing the chuck, wipe it clean, and also the screw on the mandrel, or dirt may throw the chuck out of truth. Always keep a fair-sized lubricating oil squirt at hand, and a small bottle of petrol, well corked (with a rubber cork for preference, or a well-fitting ground-in glass stopper), and keep this bottle away from artificial light or the soldering-stove.

Petrol is very useful, but it is not safe to keep much of it about. Therefore, when the car or cycle-house and shop are combined, it is essential, before commencing any work necessitating the use of the gas-blower or soldering-iron heating stove, to empty out all petrol from the tanks into the petrol cans, and remove these from the building.

A selection of rags in various stages of cleanliness may be kept in an old box, together with some cotton waste; but this latter is bad for cleaning the lathe or engine, as pieces hang about and get mixed up with the springs, and catch up on split pins, etc. The lathe-bed, however, can be wiped with waste with advantage. "Club" aluminium paint (which is sold in the form of a powder to be mixed with gold-size when required for use) is very handy for touching up repairs, as is also colourless quick-drying varnish and quick-drying black paint, which should be kept in the shop, so that any repair can be quickly smartened up. Two or three cheap tin dishes pressed out of thin sheet, and a round enamelled iron basin, will be found very useful, the former for boiling and soaking chains, and the latter for washing the hands, or testing inner tubes in water. The finest form of soap for removing stains from the hands caused by black motor-oil, killed spirit, or sulphuric acid from accumulators, is borax extract of soap. It is cheap, works well with cold water, and does not injure delicate skins.

All cracks between floorboards should be filled with thin slips of wood. Roof battens planed down wedge-shaped, laid in with glue, and then trimmed down, do well; or if the cracks are not wide enough, caulk them with tow. The place where the work is carried out should be properly ventilated, as the fumes from the brazing hearth, etc., need clearing out. Never throw away old cycle fittings or pumps, the tubes of which will come in very handy.

This also applies to water-cocks and gas fittings. A few shelves, supported on iron angle brackets such as are used to support gas meters, should be fixed above the bench. Also two strong hooks should be screwed into the floor joists above, from which depend two pieces of stout wire rope ending in two strong hooks, at such a height from the floor that they can be made into slings to suspend the motor-bicycle whilst the wheels are removed. A wrought-iron crank bending lever is very handy; but much can be done with a very strong, large screw spanner, over the handle of which has been slipped a piece of large-bore hot-water pipe about 3 ft. long. This adds considerably to the leverage available. Some copper and brass wire, and ordinary iron binding wire, should be hung up in the shop ready at hand.

Portable Spirit Blow-lamp.—This, which will often be required, can easily be made from an old bicycle pump barrel, to which is soldered an ordinary blow-pipe, with the air nozzle pointing directly across the open end of the barrel. This should be filled with wick saturated with spirit, and the air blown across the top of the flame by means of a piece of rubber pipe slipped over the end of the blow-pipe. The pump barrel should be about 1 in. in diameter and 4 in. long. This can be used where no gas is available, and serves for soldering or light silver-soldering, but will not give enough heat for any large work.

Waterproofing Cloth

Of the many processes of waterproofing fabrics, the two best suited to amateur requirements are those in which alumina soap and resin soap respectively are employed. For the first, two solutions are necessary, a warm soap bath (1 lb. to the gallon), and a solution, slightly warm, of alum (1 lb. to the gallon). The cloth should be first passed into the soap solution and allowed to remain for about half an hour, so that the soap will penetrate; it should then be removed, wrung out, and passed into the alum solution. After removal, the cloth is again wrung out, passed once or twice through clean water, and then mangled. The object is to get the cloth saturated with soap solution, so that the alumina soap is deposited in the fibres. It should be dried in the open air. When finished, the cloth will not appear to be much altered, but it will be a little stiffer and quite waterproof. To dye the cloth at the same time as it is waterproofed, it would be necessary to add logwood extract to the soap bath and sulphate of iron to the alum; but this method is not an altogether satisfactory one.

Cloth waterproofed with resin-soap is stiffer than that proofed with alumina soap. The resin soap is made by dissolving ½ lb. of washing soda in 1 gal. of water, and then boiling it with 1 lb. of finely powdered pale resin. The resin soap solution must be added to the ordinary soap solution, the alum solution remaining as before. A resinate of alumina will be formed; this is harder, and will take a better gloss than in the other process. A slight trace of ultramarine added to the soap solution will give a whiter product.

In the oil process of waterproofing, the fabric is treated repeatedly with boiled linseed oil, which may be coloured with any suitable pigment. The oil is applied very sparingly with a brush, and the material hung in the open air until quite dry, when it is again treated and dried. Three or four coats are necessary. Oilskins are similarly made; they are more flexible, but take longer to dry.

Re-seating Cane-seat Chairs

Material, etc., for Caning Chairs.—Chair cane is split rattan cane, sold in 10 ft. to 15 ft. lengths. It is sold by weight, and is of two qualities, No. 1 and No. 2, the former being about $\frac{1}{8}$ in. wide and the latter $\frac{3}{32}$ in. wide. For six-strand diamond lacing, 1 lb. is enough for eight bedroom chairs. The cane should be soaked for twelve hours in a tub of clean cold water, rainwater being preferable, this making the cane pliable and also preventing cracking and splitting when lacing. The cane will also contract on drying and make a firm, tight job.

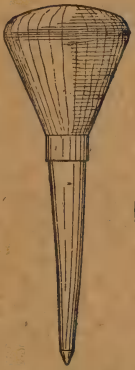


Fig. 1.—Chair-caner's Reamer

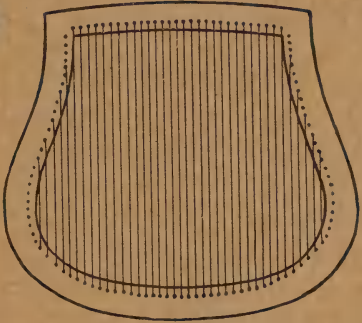


Fig. 2

Figs. 2 to 4.—First Stage in Caning Chairs

The chair-caner's reamer (see Fig. 1) is a smooth steel spike $2\frac{1}{2}$ in. long, tapering from a blunt point to $\frac{5}{16}$ in. at the tang, and firmly secured in a short hardwood handle.

A few hardwood pegs shaved from $\frac{1}{2}$-in. stuff and about 2 in. long will also be wanted.

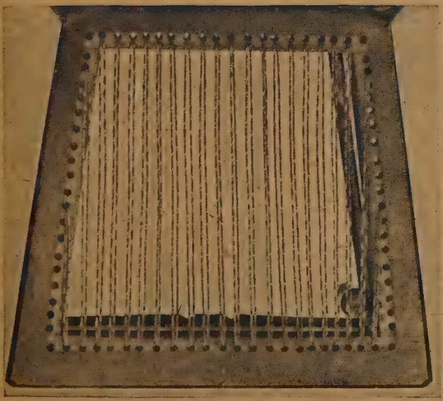


Fig. 3

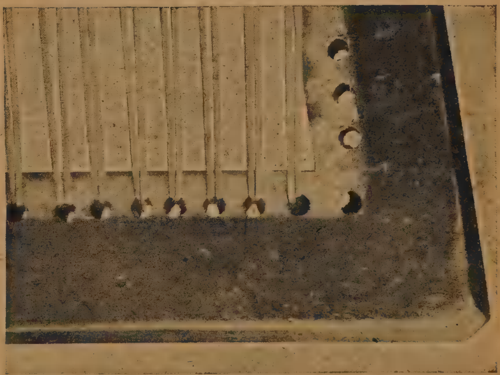


Fig. 4

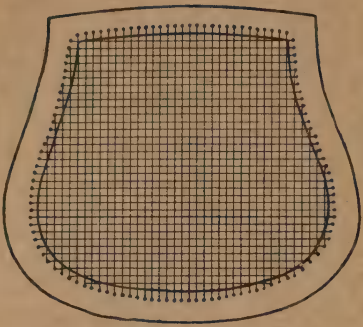


Fig. 5

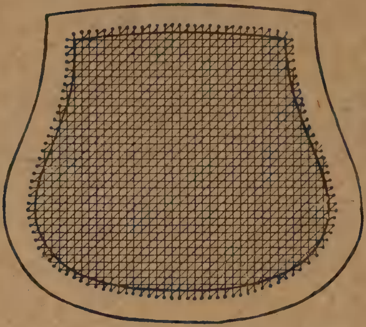


Fig. 8

Figs. 5 to 7.—Second Stage: Transverse Strands

Figs. 8 to 10.—Third Stage: First Diagonal Strands

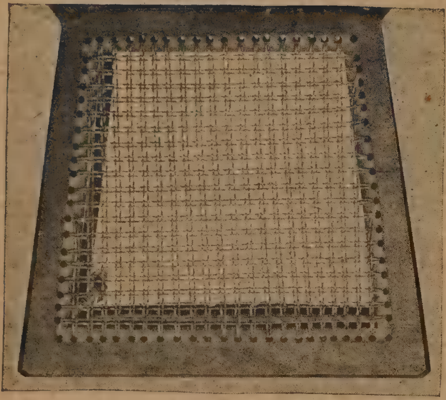


Fig. 6

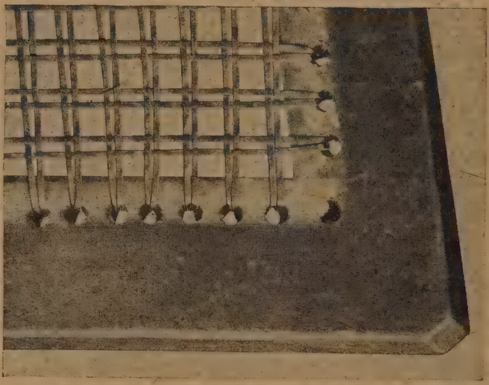


Fig. 7

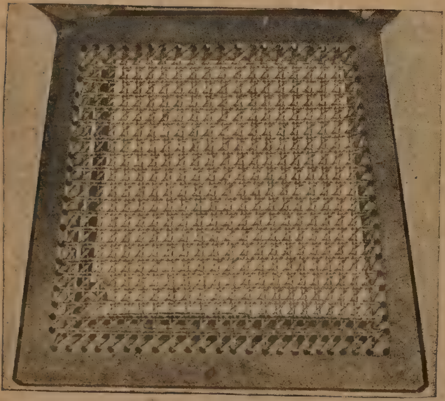


Fig. 9

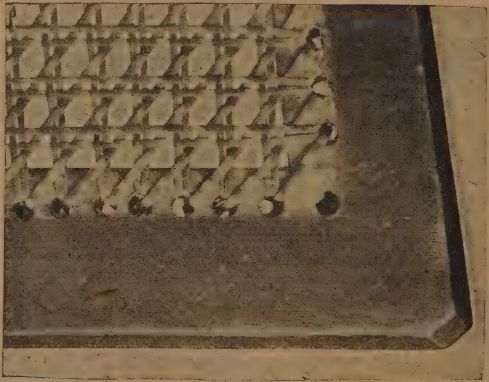


Fig. 10

In the case of re-caning the holes will already have been made, but will require to be cleared out. In new work $\frac{3}{16}$-in. holes must be bored all round; they should be $\frac{5}{8}$ in. apart and $\frac{5}{8}$ in. from the inner edges. Any staining and polishing of the frames should be done before caning.

Six-strand Diamond Lacing.—In the diamond lacing—the most usual pattern—the strands of cane square with the frame are of No. 2 stuff, and those running diagonally are of No. 1 cane, making six in all. In beginning work, place the chair on a bench or table, and pass up a strand of No. 2 cane through the centre hole on the chair front; then pass the other end of the cane up through the next hole, pull up both strands, and get them equal in length. Then cross the seat to the opposite holes and pass the cane down, pull it quite tight, and hold it with the left hand; insert the reamer with the right hand and press down. This effectually prevents the cane slipping until it has been laced to the opposite side, when the reamer should be transferred. Continue the single lacing to the last hole but one, then secure the cane with a hardwood peg and follow the same procedure with the other half of the cane, putting this through the same hole, thus making a double strand to each hole. The same operation is then done on the right of the starting point until the seat is laced from front to back (see Fig. 2). The second lacing is across the seat side to side, and is interlaced (see Fig. 5).

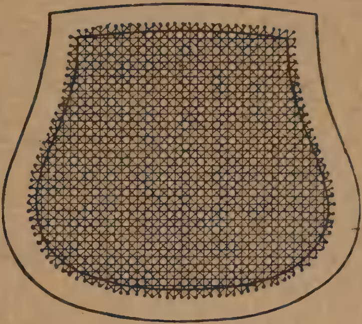


Fig. 11

Figs. 11 to 13.—Fourth Stage: Second Diagonal Strands

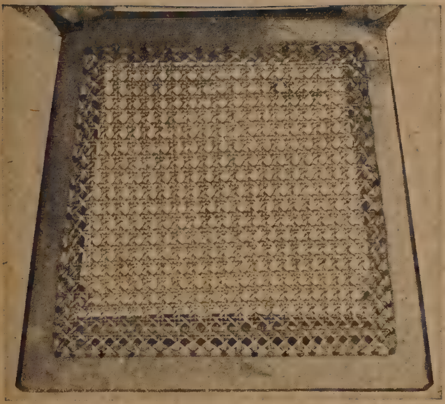


Fig. 12

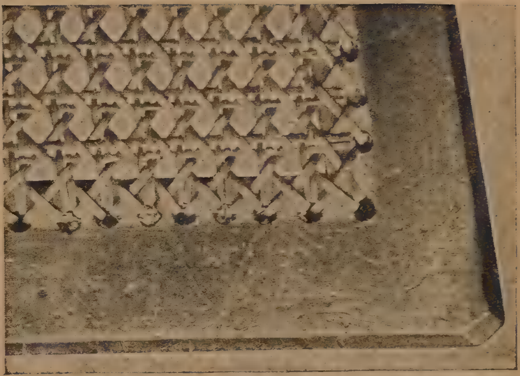


Fig. 13

In lacing, always begin in the centre of the seat frame, as this ensures the strongest part of the cane being in the middle of the seat. Secure a loose end with a hardwood peg temporarily, as the next strand of cane passed through the hole will fasten it.

The third lacing is done with No. 1 cane, the lacing going from corner to corner across the centre of the seat, and being interlaced through the squares of double cane (see Fig. 8). Next follows the fourth lacing, which will complete the diamond pattern (see Fig. 11).

Figs. 2, 5, 8 and 11 show diagrammatically the four stages thus far described, and serve also to illustrate a cheaper and weaker style in which all the strands used are single ones.

The work is frequently done in a different way, as follows: Two pieces of the narrower, wet cane are tied together at one end, and used as a single strand, as shown in the progressive diagrams presented by Figs. 3 and 4, 6 and 7, 9 and 10, and 12 and 13, which should be compared with the diagrams already referred to.

Border-caning.—To remedy the unsightly appearance round the holes, a border cane is applied (see Fig. 14). Select a stout No. 1 cane for the border, and a piece of No. 2 for tying down. Double the No. 2 cane in the centre, and pass the ends through the right-hand corner hole; open the eye or loop and slip the end of the border cane through, then pull down tight. Pass one end of the tying-down cane up through the next hole but one, then over the border cane and down through the hole again, the border cane being kept straight and free from puckers. Continue tying down at each alternate hole, as is clearly shown in Figs. 15 and 16.

When the whole is laced, allow it to dry slowly, then brush up with a hardbristle furniture brush. The use of varnish or polish as a finish is quite superfluous.

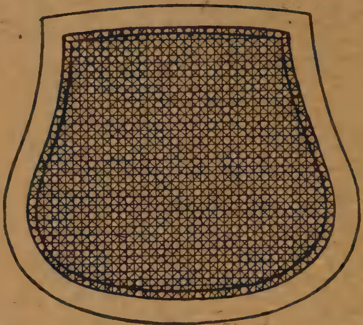


Fig. 14

Figs. 14 to 16.—Last Stage: The Border or Binding

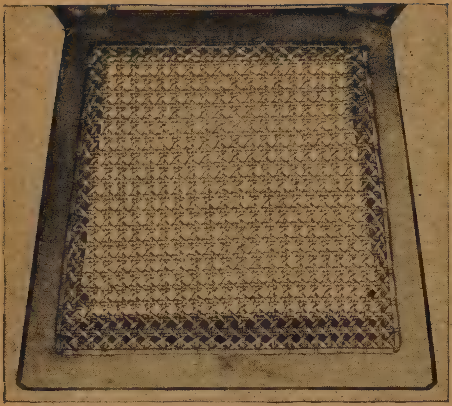


Fig. 15

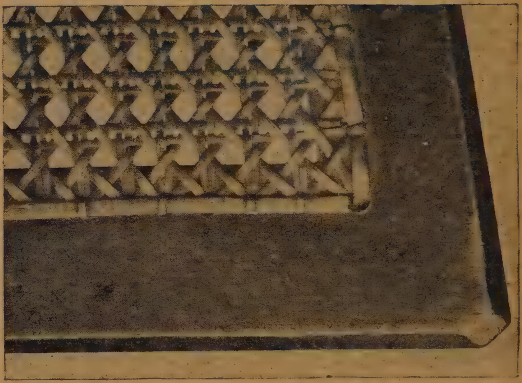


Fig. 16

Renovating Baggy Seating.—Discoloured and baggy seats can be renovated by well swilling with boiling water until the cane is thoroughly wet, and then putting the work in a strong draught of air to dry. The subsequent contraction will bring up the seats tight and level. Do not use soda or soap in the water.

Fixing Perforated Plywood Seats on Chairs.—The cheaper and simpler method of putting on perforated plywood seats is often adopted in reseating old cane-bottomed chairs, but they do not last so long as might be expected, because the cheap varnish soon wears off, they then get soiled, and the water used for washing them softens the glue in the plywood, which then parts and cracks to pieces. By being well varnished, both on the sides and in the holes, they will last considerably longer.

At most hardware stores the seats can be bought in various sizes, square, round, and shaped; and the usual way is to get one something near the size and shape, and fix it on with a dozen brass-headed nails, some of which go into the cane holes and fail to hold. Such seats seldom fit, some of the cane holes remaining uncovered.

It is best to cut a paper pattern of the chair seat, allowing ½ in. of the wood frame to show all round, and to obtain a seat large enough to cut down to the correct size. It must be cut with a fine saw (a coarse saw will splinter three-ply wood), and, if circular or shaped, a bow-saw or fret-saw should be used. The edge should be trimmed with a small plane or spokeshave and smoothed with glass-paper, and the seat should then be fixed with the brass-headed nails about 2 ins. apart, and about ¼ in. from the edge.

Fitting Upholstered Seats to Old Cane-seated Chairs.—An excellent way of treating worn-out cane seats is to attach a seat in " pin-cushion " upholstery. Not only does it last considerably longer than a cane or perforated-wood seat, but it gives the chair a superior appearance.

For example, Fig. 17 shows a cane-seated chair in need of repair, and Fig. 18 shows the same chair with a new upholstered seat.

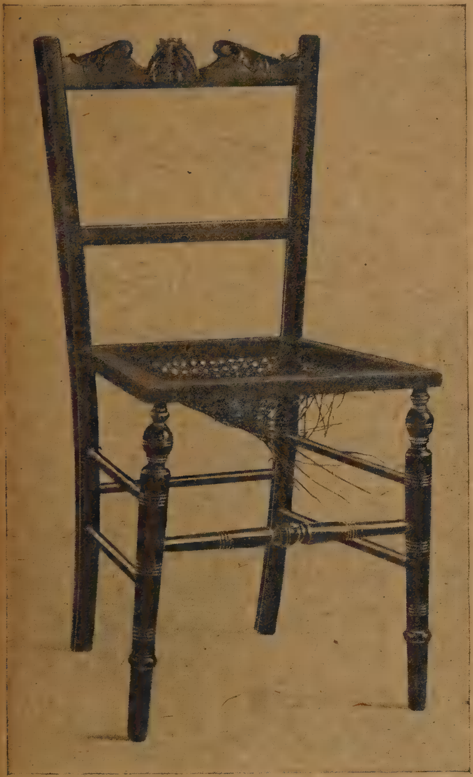


Fig. 17.—Cane-seated Chair to be Re-seated

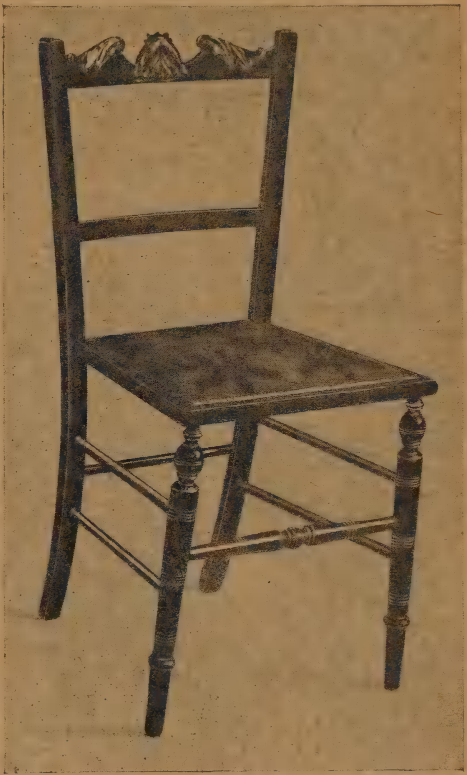


Fig. 18.—Chair with New Upholstered Seat

The best way to remove the old cane is to cut through the loops on the under side, and pull it off from the top. It is then webbed in the manner shown by Fig. 19, using No. 12 English web and ½-in. tacks. Begin by doubling the end of the web for about 1 in., and tack to the centre of the back rail. The tacks are only partly driven at first because the seat frame is not solid or strong enough to hammer on unless supported by an iron weight underneath. The web is stretched tight and tacked on the front rail, cut off, doubled over and three extra tacks put in. Another web is tacked on at each side of it in the same way and two across, woven in (see Fig. 19). The seat frame is marked round $\frac{1}{2}$ in. from the edges, and a piece of canvas is next tacked over the webbing, stretched as tight as possible, doubled over a little on the edges, and secured with $\frac{3}{8}$-in. tacks. A little flock or hair stuffing is next laid evenly over and covered with a piece of sheet wadding; then a final cover of tapestry is put on, taking care to get the pattern uniform. The seat is less than 1 in. in thickness in the centre, tapering to the thickness of only the cover at the edges, and it is tight and firm. It will get softer after being used for some time.

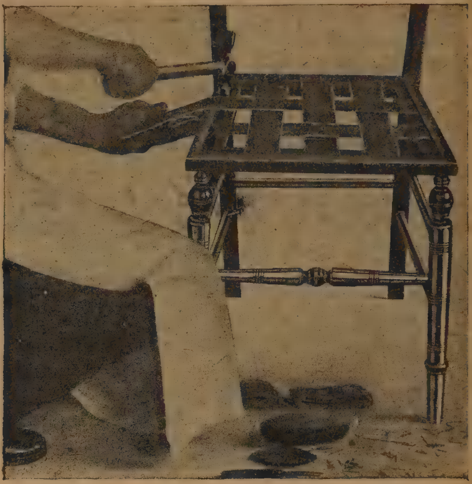


Fig. 19.—Tacking Webbing on Chair Frame

To cover the tacked edges, $1\frac{1}{2}$ yds. of gimp is required, of a colour to match the stuff. The gimp is fixed with fine $\frac{3}{8}$-in. white gimp pins, about 1 in. apart. The finishing should be executed exactly as shown in Fig. 18 (on the preceding page), which illustrates the chair fitted with its new seat.

Cleaning Floor Tiles

For cleaning glazed terracotta floor tiles, a rub with a dry or slightly damped flannel is all that is necessary.

Unglazed floor tiles may show a white scum on the surface, caused by the evaporation of the lime and cement used in the foundations; in cases where the tiles have been laid on new foundations, this scum may continue to appear for some months, but it does not injure the floor, and the scum may be easily removed.

Floor tiling is best cleaned with soft soap dissolved in tepid water and applied with a hand scrubbing-brush.

Paint spots or similar stains, and also some cement marks, may be removed by pouring on them a small quantity of sulphuric acid diluted with an equal quantity of water and allowing it to remain for a few hours. It should then be washed off, and, if necessary, again applied till the stain has disappeared. To remove cement from unglazed tiles it is often necessary to scrape and rub them. The cement may be in the pores of the tiles, and it is well known that glazed tiles which have been laid are difficult to use again if taken up, owing to the impossibility of getting the cement off their backs.

Unglazed tiles can be brightened by the use of paraffin, and the smell goes off in about two hours. The paraffin need only be applied sparingly about once a month. Animal or vegetable oils are too thick, and inclined to dry as a film on the surface, whereas paraffin soaks in.

For removing ink stains, use dilute nitrous acid. Particular care should be taken when using acids, as they will burn both hands and clothes. A piece of old flannel may be used for washing the acid from the tiling.

Soldering, Soft and Hard

How Soft Soldering and Hard Soldering Differ.—Soft soldering is quite distinct from the method known as hard soldering or brazing. This may be demonstrated by taking two brass tubes, one containing either a silver-soldered or a brazed joint and the other a soft-soldered joint. The silver or the spelter that fuses to form the brazed joint alloys itself so intimately with the brass of the tube that it actually becomes part of the tube itself, whereas, in the case of the soft-soldered joint, the soldering is more or less surface treatment; true, the joint may have been thoroughly "sweated," and thus rendered strong and sound, but still the soldering is a surface treatment compared with the silver-soldered or the brazed joint.

But soft soldering is not always inferior to brazing. Indeed, the surface nature of the soldering often constitutes its value, especially in the case of galvanised and tinned iron or steel, zinc, pewter, etc., for which metals brazing would be out of the question.

SOFT SOLDERING

Soft soldering is a means of joining together various metals, such as sheet copper, brass, iron, zinc, pewter, and tin-plate (tinned steel), and although most novices try their hand at it, few acquire anything like dexterity with the copper bit. However, if the following hints and instructions (based on a long and practical experience) are adhered to, no insuperable obstacles will be encountered.

Fluxes.—The flux most generally used for tinned iron, tin-plate, copper and brass is zinc chloride (killed spirits of salts); not only does this act as a flux on the solder, but it helps to clean the surfaces of the metals. It may be prepared by placing small pieces of zinc into a clean stone jam-jar half filled with spirits of salts and leaving until effervescence entirely ceases. Resin, and resin and oil are also used as fluxes for these metals when the surfaces have already been cleaned, their advantage being that they do not give rise to ultimate rusting, as in the case of an acid flux. In soldering new dairy utensils, gas meters, electrical apparatus, gas fittings, etc., it is not permissible to employ an acid flux.

A good flux for zinc consists of equal parts of "raw" and "killed" spirits; but galvanised iron, whether new or old, requires "raw" spirits of salts without dilution, this being soon converted into "killed" spirits by its immediate action on the zinc with which the iron (actually steel) is coated.

Tallow, resin, and resin and oil are suitable fluxes for pewter, tin and lead, and on no account should spirits of salts be used. A number of indifferent fluxes, known as "soldering solutions," have appeared from time to time, but these have now given place to a very serviceable flux known as "Fluxite," which answers admirably for most metals, and which is deservedly becoming more popular. There is an excellent combination soft solder and flux, known as "Bri-tinol"

Copper Bits.—Solder is generally applied by means of a "bit" (miscalled an "iron"), the heat from which causes the solder to flow. The copper bit shown in Fig. 1 may be made by drilling and tapping a short length of $1\frac{1}{2}$ in. or 2 in. square copper to receive the screwed end of a rod of $\frac{5}{16}$-in. iron, the copper being afterwards heated and drawn to a point or blunt edge as preferred. This forms a good bit for all ordinary purposes.

An axe-head or hatchet bit is one having the copper head riveted in the eye of the iron rod as shown in Fig. 2, the bit, however, being free to revolve, as this is essential when making joints in heavy lead pipe, for which purpose it is principally used. Fig. 3 represents a bit which is a combination and modification of the two others, and it is largely used for the internal soldering of bottoms of large drums, milk churns, etc., where great local heat is required.

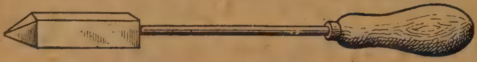


Fig. 1.—Ordinary Copper Bit

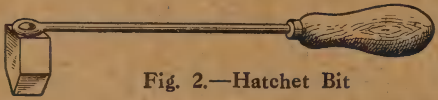


Fig. 2.—Hatchet Bit

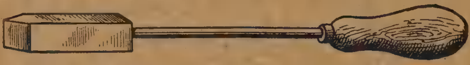


Fig. 3.—Bit for Internally Soldering Vessels

Although a copper bit may be heated in any fire, it is better to avoid the dirt, smoke, and tarry stickiness which are often present in a coal fire. Gas is an ideal fuel, which may be regulated at will to give a uniform temperature, and two gas-stoves specially designed and constructed for the purpose of heating copper bits are here shown (see Figs. 4 and 5). In the absence of gas, a bright, clear coke fire should be used whenever available. Portable oil stoves of the wickless type can also be employed. A bit can be well heated in a gas-heated laundry-iron.

Solders.—Solders vary in fusibility according to their composition, the nature of the work and the properties of the metal to be soldered being two important considerations. Should a solder be used of a higher degree of fusibility or melting-point than the metal to be soldered, the metal will be ruined by melting, before the solder has fused. A point to be particularly observed is that the introduction of a foreign substance into the solder—for example, the addition of a little zinc to a pot of "very fine" solder—will spoil it and render it unworkable.

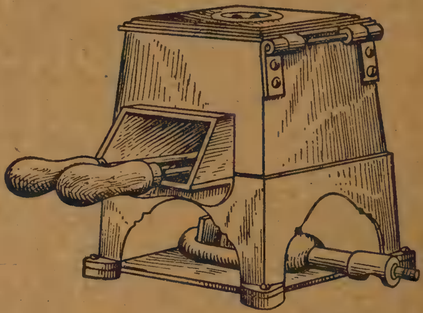


Fig. 4.—Gas-stove for Heating Soldering Bits

A coarse solder—one used chiefly for plumbers' wiped joints—consists of 2 parts lead to 1 part tin. A good ordinary soft solder for use with a copper bit is composed of equal parts of lead and tin, while a solder consisting of 1 part lead to 2 parts tin is "very fine" indeed, and may be

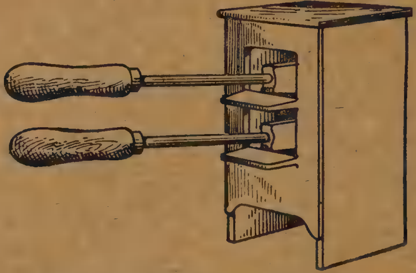
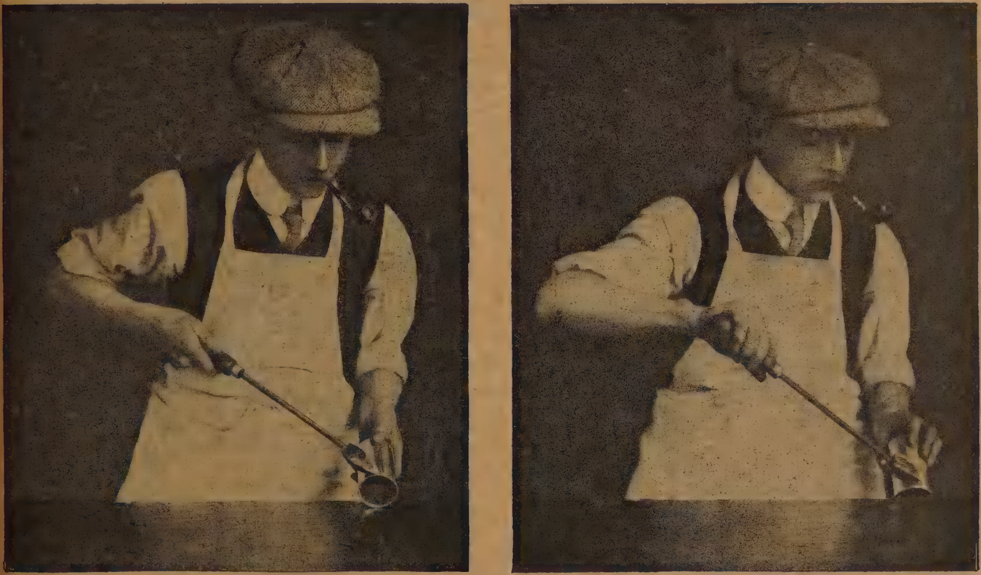


Fig. 5.—Another Type of Gas-stove

used for most high-class work. For soldering pewter, a solder having a low degree of fusibility is required; it should be composed of 1 part lead, 1 part tin, and 2 parts bismuth. It is false economy to use a rough solder for fine work on the score of cheapness, since more solder is required for a given job on account of the rough particles of solder clinging to the work; moreover, the rough appearance of the soldering may completely spoil the job.



Figs. 6 and 7.—Incorrect and Correct Ways of Holding Soldering Bit

Tinning the Bit.—To ensure success the point of the bit must be well tinned and maintained in that condition, it must be sufficiently hot, the work to be soldered must be thoroughly clean, and the solder and flux must be suitable. First of all, the point of the copper bit must be tinned as follows: Place it in the fire or stove until the copper begins to change from a black to a dull red heat. Withdraw it, and file about an inch of the extremity on all the four sides until a straight uniform surface is obtained. Now dip the point of the bit into the pot of "killed spirits" and touch it with solder, which should immediately run all over the prepared surface; another dip into the "spirits" completes the operation. A sharp "pop" as soon as the bit touches the spirits indicates the right temperature of the bit; excess of smoke and much spurting of the spirits shows that the bit is too hot; should the bit not be hot enough it will be damp and insufficiently cleaned on withdrawing it from the spirits. Some workers have at hand a pot of water in which has been dissolved a small lump of sal-ammoniac, and they clean the bit in this; but it is quite unnecessary when "killed spirits" is used.

Simple Soldering.—The work must be filed, scraped, or otherwise mechanically cleaned, and then coated with the flux just where the soldering is required. Apply the flux by means of a small brush. Heat the copper bit (do not let it get even to a dull red heat), and lightly dip it into the spirits to clean the point; then, with a small button or blob of solder resting on the work, place the bit momentarily upon it to cause the solder to flow, and draw the bit where the solder is required. Many beginners try to draw along the solder with an insufficiently heated bit. The result is a series of lumps—"putting it on with a trowel," as it is sometimes termed. A good joint cannot be made this way, however much solder may be used. Some beginners fly to the other extreme, and try to make a neat job with a red-hot bit, which results in the solder assuming a sandy appearance and in the work being discoloured. Others try to solder up-hill—that is, they hold or place the work in such a way as to cause the solder to flow away from where it is required. The correct method is to solder down-hill, so that the solder will alway collect around and travel with the point of the bit. This, besides facilitating the work, makes a strong joint, and imparts a clean and neat appearance to the job.

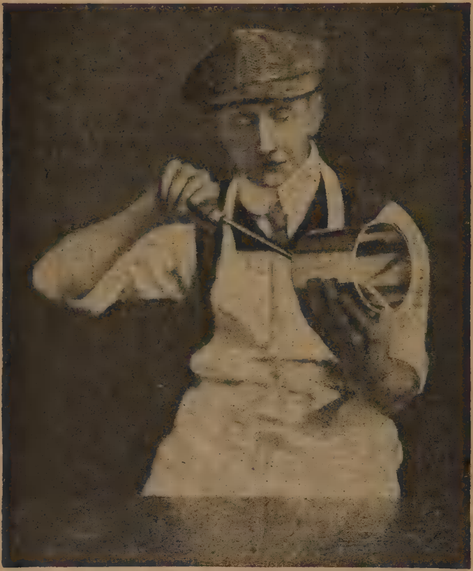


Fig. 8.—Internal Grooved-seam Soldering

A mistake common to amateurs is to hold the bit in a cramped and awkward way, as in Fig. 6, in which illustration it will be noted that the hand is wrongly twisted under the handle, the thumb being brought to the top and the elbow forced to the side. The correct positions of arm and fingers are shown in Fig. 7; the elbow is held well out from the body, and the thumb is placed directly under the handle of the bit, forming a fulcrum over which the bit may be slightly raised or depressed at will. This is all-important when soldering very fusible metals such as pewter, tin, etc., on which the weight of the copper bit should never be allowed to rest, as otherwise a hole will suddenly be made in the work. The whole weight of the bit should be supported and balanced on the thumb by the downward pressure of that part of the hand close to the little finger. The worker should not for a moment lose control of the copper bit, and control is always assured when the thumb is underneath the handle. "Down-hill" soldering may be obtained by tilting or inclining the article to be soldered, as illustrated.

Making Soldered Joints.—There is but little strength in a butt joint with the edges of the metal only just touching, that is, without a lap; to take the example of a small cylinder, the body seam should have at least a $\frac{1}{4}$-in. lap. Fig. 8 represents an example of internal grooved seam soldering, which may be executed in the following way. After applying the flux, place a small button of solder inside the cylinder on the seam, rest the bit momentarily on the solder to melt it, and then draw it gently along the seam. Note that the hand which holds the cylinder avoids touching that part of it which comes directly in contact with the copper bit, as otherwise the hand would be badly burned. Note also that the cylinder is slightly tilted to allow of the solder travelling with the point of the bit.

Fig. 9 illustrates the method of internally soldering the bottom on a canister or similar article. It will be seen that the bottom is held in position by gently pressing it against the bench during the soldering process; the tilt of the canister and the position of the bit cause the solder to travel with the bit.

In soldering these and similar articles the soldering should be done with one sweep of the bit, the left hand meanwhile making the necessary revolution. This saves time and solder, and avoids the unsightly appearance of a series of starts and stops. Always avoid the practice of some amateurs, who rest the bottom of the article to be soldered on the bench during the soldering process. By this method much dirt and dust is liable to be picked up off the bench, and the flow of solder interfered with.

When the work is of a larger and more substantial nature, as, for example, in galvanised or tinned iron work, the bottom of the article is first "knocked up," and then soldered internally. Fig. 9 represents an example of internal soldering where the whole weight of the bit is shown resting on the molten solder inside. This is necessitated on account of the great local heat that is required to "sweat" the solder into the four thicknesses of metal which constitute the bottom seam; and for this work the bottoming bit shown in Fig. 3 is often used.

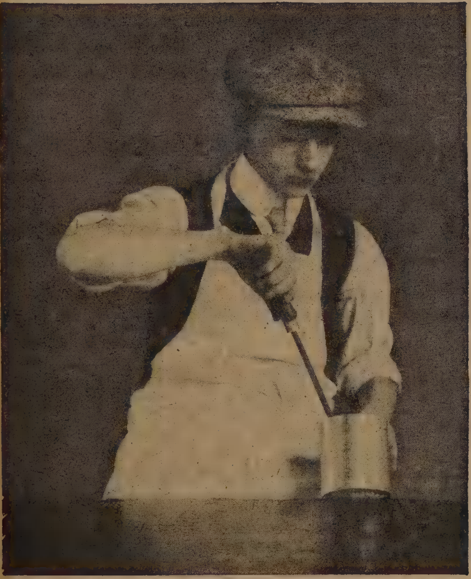


Fig. 9.—Internally Soldering Bottom on Can

Pewter, lead, zinc and tin—the latter should not be confused with tin-plate—do not require sweating, on account of their low fusibility, and any attempt even to solder them with a very hot bit will probably end disastrously.

An example of external seam soldering is shown in Fig. 10, which represents the soldering of a cylinder body. This method is invariably adopted for simple lap seams, although grooved seams are similarly soldered. A grooved seam, however, should preferably be soldered internally. Note again, the position of the worker's elbow and thumb, and observe the tilt of the cylinder (more pronounced in this case than the other) in order to secure the down-flow of the solder.

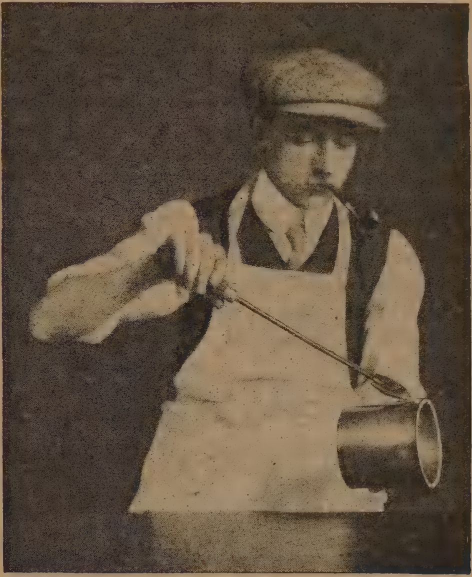


Fig. 10.—External Seam Soldering

Soldering without a Bit.—Although soft soldering is usually associated with the use of a copper bit, quite a number of jobs can be done without one. Most joints in lead, tin, and compo. pipe are now preferably made by means of a blow-lamp, or with a mouth blow pipe. Strip-solder is used. When making the joint, heat the pipe in the immediate vicinity, and, dipping the solder in the flux, stroke it around the pipe to form the joint. Other jobs may be similarly negotiated without having recourse to a copper bit. Taking the familiar case of refixing a spout in a tinned wrought-iron or copper kettle, for example, the spout and that part of the kettle which comes in contact with it should first of all be filed bright and clean. Now place the spout in position, apply the flux (killed spirits), and hold it over a Bunsen flame, as in Fig. 11, until sufficient of the strip solder is melted to flow around and sweat through to make a strong sound joint. Should any difficulty be experienced in getting the solder to flow readily, apply a little more flux.

When the surface of the metal to be soldered is corroded badly, and it is difficult to obtain a clean, bright surface preparatory to soldering, it should be treated to a liberal application of raw spirits of salts (hydrochloric acid), which will soon remove the cause of the trouble, but all traces of the acid should be washed away with clean water before attempting the soldering. It is also a good plan in these cases to tin the surface by repeatedly rubbing it with a hot bit and solder, together with plenty of killed spirits, before proceeding with the actual soldering process.

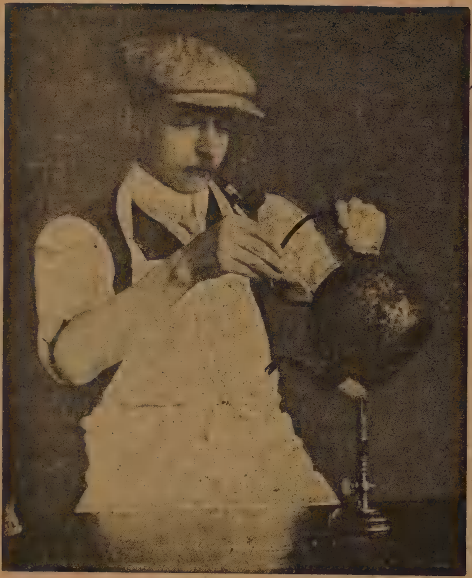


Fig. 11.—Soldering without a Bit

Scrupulous cleanliness in everything connected with the process of soldering is essential to success.

Soldering with Zinc as the Solder.—Zinc may be used as a solder for iron, galvanised iron, copper and brass, the flux being ordinary killed spirits. It is inconvenient to use a soldering bit (it cannot apply sufficient heat) and it is essential that the parts to be joined should be thoroughly well heated, plenty of flux used and the heating continued until zinc readily melts upon the surface of the heated work. The method recommended is to spread the zinc on the surfaces to be united and, after heating, knock the work slightly, the vibration then causing the molten zinc to spread. Zinc has a great affinity for iron and will readily coat it, but care must be taken to see that the surfaces to be joined are chemically clean. The use of zinc produces a much stronger joint than when ordinary soft solder is used, as the melting point of the former is about 800° F., while that of the latter is only about 300° or so.

SOLDERS FOR VARIOUS METALS

The following table (due to "Machinery") gives the fluxes and the compositions of soft solders suited to a number of different metals :—

Soft Solders for Various Metals.

Metal to be soldered	*Flux*	*Soft solder*		
		Tin	*Lead*	*Other constituents*
Aluminium	stearin	*see table on p. 81.*		
Brass ..	chloride of zinc, resin or chloride of ammonia ..	66	34	
Gunmetal		63	37	
Copper ..		60	40	
Lead ..	tallow or resin ..	33	67	
Block tin	chloride of zinc ..	99	1	
Tinned steel	chloride of zinc or resin	64	36	
Galvanised steel	hydrochloric acid	58	42	
Zinc ..	hydrochloric acid	55	45	
Pewter ..	gallipoli oil ..	25	25	bismuth, 50
Iron and Steel	chloride of ammonia	50	50	
Gold ..	chloride of zinc ..	67	33	
Silver ..	chloride of zinc ..	67	33	
Bismuth	chloride of zinc ..	33	33	bismuth, 34

The "chloride of zinc' mentioned in the above table is the familiar "killed spirits."

SOLDERING ALUMINIUM

Soldering aluminium is one of the most debated subjects in metal working, chiefly for the reason that it cannot be done satisfactory by the usual soldering method.

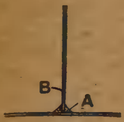


Fig. 12.—T-joint in Aluminium

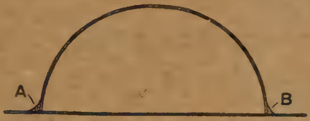


Fig. 13.—Jointing Semi-circular Work

Almost as soon as aluminium was prepared on a large scale, it was discovered that the ordinary solders and fluxes did not answer when applied to aluminium. While it has long been known that either pure tin or pure zinc would wet aluminium, and could, therefore, be used as solders for it, experience shows that the tin soon falls apart, while zinc by itself is brittle and discolours badly. The failure of tin is due to the fact that it forms an alloy with the aluminium, which is decomposed by the action of the atmospheric oxygen.

Aluminium is popularly supposed to be non-oxidisable; but really the surface is covered with a very thin film of oxide, which prevents the solder from alloying with the aluminium. The heated aluminium rapidly oxidises, thus preventing the union of the metal with the solder. The customary method is to scrape the metal before and during the soldering. Some workers say that it is useless to scrape before soldering because oxidation immediately recommences; but it must be remembered that a thin film is certainly easier to penetrate than a thick one. Often it answers to scrape with the copper bit during the soldering, previously rubbing off the oxide with emery cloth. The work should, if possible, be backed with asbestos, to keep up heat on the metal. To see that the surface is thoroughly tinned, wipe off lightly, and the untinned parts will soon become apparent. If the oxide is not scraped off beforehand, it will probably mix with the solder and form a scum, which will make a neat flow difficult. When this appears it can be lightly removed with an old knife-blade. It is quite necessary to tin every part to be joined, as the solder will not take where not rubbed in some way, unless previously coated.

Solders for Aluminium.—Numerous patents have been granted for aluminium solders, naturally all claiming to be strong and durable, the alloys containing various metals, such as aluminium, antimony, bismuth, cadmium, chromium, copper, lead, manganese, silver, phosphor tin, tin, and zinc. Lower down in this column is a table of aluminium solders.

Many of the best solders for aluminium contain a small proportion of phosphor tin. A molten alloy containing phosphorus placed on aluminium tends to absorb oxygen from the impure film as well as the surrounding air. In making the above solders, it is advisable to avoid loss of the more easily volatile of the metals by adopting the following precautions: The aluminium is melted first, the zinc is added in small pieces, then tin in small pieces, and lastly the phosphor tin.

Compositions of Aluminium Solders

Tin	*Zinc*	*Silver*	*Aluminium*	*Copper*	*Bismuth*	*Phosphor Tin*	*Cadmium*	*Lead*	*Antimony*
72·5	25	—	1·5	—	—	1	—	—	—
80	20	—	—	—	—	—	—	—	—
97	—	—	—	—	3	—	—	—	—
20	—	10	70	—	—	—	—	—	—
90	—	—	10	—	—	—	—	—	—
65	27	5·75	2·25	—	—	—	—	—	—
30	20	—	—	—	—	—	50	—	—
99	—	—	—	1	—	—	—	—	—
90	—	—	—	9	1	—	—	—	—
6	77·5	—	3·25	—	—	—	—	3·25	—
—	90	—	6	4	—	—	—	—	—
—	80	—	12	8	—	—	—	—	—
—	80	—	20	—	—	—	—	—	—
—	90	—	5	—	—	—	—	—	5
80	17	—	2·25	—	—	·75	—	—	—
75	22	—	2·5	—	—	·5	—	—	—
70	25	—	3	—	—	2	—	—	—

Fluxes for Aluminium.—A large variety of fluxes have been tried with more or less success, namely, borax, copper chloride, lithium chloride, paraffin, resin, sal-ammoniac, stearin, silver chloride, tin chloride, venetian turpentine, tallow, vaseline, and zinc chloride. Stearin is undoubtedly the most reliable flux, and is the one best adapted for the solders given in the table above.

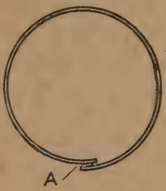


Fig. 14.—Jointing Cylindrical Work

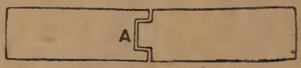


Fig. 15.—Jointing Bars or Strips

The Soldering Bit for Aluminium.—The average temperature required to make a satisfactory and thoroughly sweated joint in aluminium is from 650° F. to 680° F., according to the size of the article to be soldered. A blow-pipe or blow-lamp will be of great value to assist the soldering bit. An aluminium bit or a nickel bit is superior to the ordinary copper bit, the point and the soldered joint being kept much cleaner whilst removing the film of oxide during the soldering operation. Another advantage is that the point or "face" of the bit can be tinned with the same flux as that which is used for the joint. More care must be taken in the manipulation of the aluminium soldering bit owing to its lower melting temperature than the copper and nickel bits.

How to Solder Aluminium.—The soldering of aluminium must be performed quickly to be satisfactory, as an aluminium surface, not coated at the first attempt, may be injuriously affected. Tinning the parts required to be soldered first is another important factor; also the distance of the overlap of the joints should not exceed more than $\frac{1}{8}$ in., so as to allow the solder to thoroughly flow through. Solder does not flow so readily through an aluminium joint as when soldering other sheet metals.

Before engaging on a large job, get several pieces of aluminium sheet, No. 20 B.W.G. to No. 16 B.W.G., cut two pieces about 2 in. square, and solder together as shown by Fig. 12 at A. If properly soldered as instructed, try to break the soldered joint, and it will be found that the aluminium sheet itself will fracture first at B. Next cut two pieces 4 in. square, bend one semi-circular as shown in Fig. 13, and solder at A and B. Next turn a ring as in Fig. 14, and solder at A, of course previously tinning the lap.

In soldering large pieces as shown by Fig. 15, where the ordinary overlap is not allowable, and where a butt joint would not be strong enough, fit the pieces together as at A. This will necessitate a higher temperature than that which is required in making the joints shown by Figs. 12 to 14.

Solder always flows towards the hottest point. This tendency enables one to direct its course under the blow-pipe or blow-lamp flame. A large flame should only be employed in "heating" up the part to be soldered on large and heavy work. With a small pointed flame directly on the solder and the parts on which it rests, the solder will flow quickly, and leave a smooth, even surface at the completion of the operation.

Some solders now on the market are so hard that it is necessary to heat them and the work to redress before they melt. Aluminium does not require a great heat to warp it, and it also contracts badly. If the solder is too high in melting point, the metal must also be brought to that point to cause proper union. If a hole is being filled in, the body of the metal on heating expands all round and partly closes the hole; also both the solder and the patch whilst hot are slightly expanded. In cooling, the hole enlarges, the patch contracts, and the solder also contracts; cracks result. The body of the work, if not exactly evenly made, will warp, which is fatal to engine and similar work. By using a low-heat solder (melting-point, about 700° F.) these troubles should be avoided.

Aluminium can be readily soldered to copper or brass by the following method with ordinary solder, namely, an alloy of 2 parts of tin and 1 part of lead: tin the metals, using stearin as flux previous to making the required joint.

SILVER SOLDERING

Soft soldering, as already described, is done with solders most of which are easily fused with a black-hot bit; the fusing of hard solder requires a small blow-pipe flame, while the use of brazing spelter requires the heat of a powerful forge or large blow-pipe. The strength of the joints made by these three methods is in the order in which they are here mentioned, starting with the weakest.

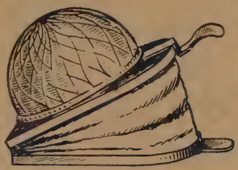


Fig. 16.—Foot Bellows

It is impossible to progress very far in the art of metal working, especially in silver, brass, copper, etc., without a knowledge of hard soldering, as necessarily nearly all ornamentation to a piece of work, to say nothing of handles to cups, etc., must be attached by this method. The best way to approach the subject is to gain a knowledge of the why and wherefore of every step, and with this end in view it is advisable to begin with a few simple experiments, which will serve to show in their first stages how *not* to do things, and finally how they should be done. Before doing so a description of the requisite appliances and their respective uses will be necessary.

Blow-pipe and the Air Supply.—With a gas supply in the workroom, the tools required are few, and, with the exception of the bellows, inexpensive. Even if a gas supply is unobtainable, the work can be equally well done with spirit apparatus.

Fig. 16 shows a foot bellows, of which the rounded top part under the net is a rubber disc to contain the air, the rubber, when expanded with air, causing by its elasticity a continuous pressure of air to flow to the burner, shown in Fig. 17, by way of rubber tubing. The net covering the rubber disc is important, preventing as it does the rubber being over-expanded by too much foot pressure.

A useful type of blow-pipe is shown by Fig. 17. Of the two pipes of which it is composed, the upper is the air pipe, and must therefore be attached to the bellows by means of the rubber tubing. The lower pipe is for the gas supply, and is attached in like manner to the gas pipe on the wall. The lever A (Fig. 17) regulates the supply of gas. Having connected the tubes, turn on the gas, move the lever on the soldering burner forward with the thumb of the right hand (grasping the instrument in that hand), and light the gas. By moving the lever backwards or forwards, the size of the flame can be regulated. Place one foot on the iron step on the bellows and press downwards, when the flame will immediately become concentrated.

In beginning to solder a piece of work it is advisable to make several movements with the leg downwards to get a good supply of air into the rubber bag. A little practice will make the regulation of the flame become an easy matter, a most important point in soldering, for reasons which will be demonstrated later on.

Other Requisites.—An asbestos or charcoal soldering block will also be required. This is necessary to place the work on during soldering, and can be used actually on the work-bench or held in the left hand. It will be advisable to begin with it on the bench, and so lessen the chance of getting the fingers burnt.

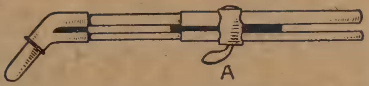


Fig. 17.—Blow-pipe

A borax slab and a few lumps of borax are the next items required, and if expense is a consideration, an ordinary piece of slate about 3 in. square serves the purpose of a slab admirably; and this, like everything else used in soldering, must be kept scrupulously clean.

Having thoroughly cleansed the slab by washing (in water only), a few drops of water must be sprinkled on it. Now take a small lump of the borax, and rub it on to the slab. The borax will mix with the water, and when about the consistency and colour of milk is ready for use. The water with which the borax is mixed is only used as a means of distributing the latter evenly over that part of the work to be soldered. The water, of course, evaporates directly any heat is applied, leaving a film of dry borax only. Borax melts with heat, and besides helping the solder to flow, it protects the silver from collecting a film of oxide, which would prevent the solder flowing. A small camel-hair brush will be required to convey the mixed borax to the article to be soldered, and the method of applying it is important.

The silver should be thoroughly cleaned by scraping lightly, but only where the solder is to run. In this connection it may be stated that the thinner the line of soldering the neater the job; and so long as the solder runs freely, as it will if all instructions are faithfully carried out, there need be no fear of a weak joint. The borax should be applied with the brush lightly along the line scraped on the silver, and not beyond it anywhere, as wherever borax is applied the solder will be inclined to run, and so tend to make a clumsy joint.

Silver Solder.—Silver solder is simply silver alloyed with a little brass to bring down its melting point below that of standard silver. Pure silver being too soft to use for any article that will have any wear and tear, or even constant cleaning, standard silver, that is, silver alloyed with a small proportion of copper, is used for nearly everything but a few articles of jewellery ornamented with high-fusing enamels.

In soldering two pieces of silver together it stands to reason that the material used to fix them must melt at a lower temperature than the articles themselves; but at the same time, for the sake of appearances, must partake as much as possible of the colour and substance of the work in hand. To meet these requirements, therefore, a small amount of a metal (brass in this instance) which has a lower melting-point than silver is alloyed with the latter, and the resultant alloy will, when properly handled, join the two pieces of work together without any fear of destroying them by the necessity of applying too much heat.

The solder may be purchased of various thicknesses, and it will be necessary, when the worker has become fairly proficient, to have in stock some of each for use, according to the size and thickness of the work in hand. It can be readily understood that if a very thin piece of solder be placed on to a thick piece of silver with the idea of soldering, the heat from the blow-pipe will melt the solder long before the thicker silver has absorbed sufficient heat to induce the solder to flow on to it, and the result will be as shown in experiment No. 2.

To begin, a piece of solder of medium thickness should be bought, which will serve the purpose of all the following experiments.

First Experiment.—Take a piece of standard silver about the size and thickness of a worn threepenny-piece and place it on the soldering block. Next cut with the shears from the sheet of solder a small piece, technically known as a "paillon" (corrupted to "panel"), and place it on the silver. Anywhere will do; but for the purposes of this experiment not too near the edge. This experiment and the two following ones are to be conducted without any borax, and the silver to be unscraped to show the effect of non-compliance with these two important points. It is necessary here to explain the approximate size of a paillon of solder; an average size is about $\frac{1}{8}$ in. long and $\frac{1}{16}$ in. wide, the size depending on the character of the work in hand. The above measurements are only a rough guide to the beginner.

In cutting the solder from the sheet, the simplest way, when several panels of nearly the same size are required, is to make several slits with the shears at intervals of $\frac{1}{16}$ in., and then placing the sheet between the first and second fingers of the left hand, press the thumb against the edge where the slits have been made, and with the shears in the right hand cut across the slits. By this method (the pressure of the left thumb) the small paillons are prevented from flying about the bench and elsewhere when the cross cut is made. It is as well to have the borax slab underneath the left hand on the bench, to catch the pieces as they fall.

Grasp the blow-pipe in the right hand, arranging the soldering block with silver on it in a convenient position on the bench beneath the burner. Place the thumb on the lever, light the gas, and place the right foot on the bellows. (The latter, for convenience and to prevent injury, may be situated underneath the bench and slightly to the right hand of the operator.) Begin working the bellows, and regulate the lever on the burner until the flame is little more than half the size it would be if the gas were full on, and direct the flame right on to the paillon of solder. In a few moments the latter will be seen to get red hot, and suddenly form into a ball. Immediately this occurs, shut off the gas and stop blowing with the bellows. Drop the silver into cold water to cool, take it out, and examine it; the little ball of solder will be found adhering but slightly to the silver, and they can be easily separated.

The reasons of the results obtained are as follow: The flame being directed on to the solder, the latter became heated before the silver, and melted into a ball (being of a lower fusing point, as explained previously) long before the silver had attained the melting point even of solder. Secondly, the article, not having been cleaned and scraped, had, besides a film of oxide, probably some grease, from being handled, on it, which would prevent the solder flowing even if every other precaution had been taken to this end.

Second Experiment.—Take another piece of silver and paillon of solder, and with a knife scrape the silver where the solder is to flow. Place the paillon on the scraped part, and proceed with the blow-pipe. After cooling, it will be found on examination that, although the solder has melted (not so much in a ball), it has not run freely; but it is impossible to separate it from the silver. The different and somewhat better result as compared with No. 1 is entirely due to the cleanliness of the silver.

Third Experiment.—Proceed as in experiment No. 2; but instead of applying the flame directly on to the solder, move the blow-pipe in circles round the outside of the silver, so that for the first half minute the flame does no more than heat the edges. Then gradually reduce the circles until the solder is reached, when the latter should melt at once. If it does not, enlarge the circles once more, and again approach the solder, never allowing the flame to remain in one spot except just at the moment of approaching the solder. When heating the work as just described, a large flame is necessary; but on approaching the solder, the flame should be reduced until it is pointed. If, however, the solder does not flow almost immediately, it is useless to continue with the pointed flame, as the remainder of the work will be getting cold. Enlarge the flame, therefore, and repeat the circular motion.

The improvement found in this experiment is due to the different method of applying the heat. The silver, being thicker and of greater bulk than the solder, naturally takes longer to attain a given temperature, and must therefore have the flame applied to it for a longer time, hence the circular motion prescribed. This method will apply in every piece of work, for even supposing the case of a very small trinket, the solder will be of less bulk proportionately. Therefore, it may be laid down as a rule that the paillons of solder in use should be approached by the flame last, and taking care that if the work is of varying thickness, the flame should dwell accordingly longer on the thicker than on the thinner parts.

From the foregoing experiments it will be gathered that cleanliness is of the greatest importance, and that common sense in the application of heat is almost as essential.

Fourth Experiment.—For another experiment take a piece of silver and paillon of solder, and proceed as in experiment No. 3 with the addition of borax prepared as described. Having scraped the silver, moisten the camel-hair brush in the liquid borax, and wipe the brush gently along the scraped part. The solder, which should be previously cut and in readiness on the borax slab, and therefore also moistened, must be taken up with a pair of tweezers (not on any account with the fingers), and placed on the silver where scraped. Apply the flame with circular motion and in every way as in the last experiment. The solder will really flow this time, and not remain in a ball or lump.

So far only the flushing of a piece of solder on to silver has been described. When, however, this can be done with confidence, the joining of articles of various sizes and thicknesses is only a matter of practice; but there are one or two little points that may not be thought of. One of these which frequently occurs is when soldering a light piece of ornamental wire on an article; say, for instance, an old coin to hang on a watch chain. It is as well in this case not to cut the wire to the exact length to begin with, but to leave it a little longer than required, so as to be sure of a good joint. In beginning soldering operations, the wire will be standing away for most of its length from the coin, and it is of the utmost importance that this part of the wire standing alone should not be touched at all by the flame, otherwise the wire will drop in two.

It may be taken, then, as a rule, that any ornamentation or projection that stands away from the main body of the work should be very lightly treated with the flame. In this connection the use of whiting mixed with water and smeared over the part that there is a fear of "sweating" (the technical name for melting) is most useful, but it must be remembered that the smallest particle of whiting touching the part to be soldered will prevent the solder flowing.

After the work is finished, a few spots of a glassy-looking substance will often appear on the top of the soldered part. This is nothing but borax hardened by the heat, and can easily be removed with a fine file after the work has remained in dilute sulphuric acid for a short time, which also cleans the silver.

Soldering a Silver Box.—In working in silver, soldering is not always the ideal method of making joints; for instance, in the cigarette box shown by Fig. 18, the jointing of the corners is best accomplished by means of angle-pieces secured with very small rivets. Even in this case, however, the joint could be soldered, if the maker so desired. The corners should be brought together after binding up, and secured with binding wire during the operation, the solder line being made inside. Just moisten the joint with damp borax, and place scraps of solder along it, directing the blow-pipe jet to the solder, until it just melts. In the examples shown by Figs. 18 and 19, the lids take different forms. In Fig. 18, the sheet of metal that forms the cover is strengthened with a double thickness round the edge. The centre portion of the upper piece has been cut away, the two pieces being both riveted and soldered together. In Fig. 19 the corners are slit and mitred, and the edges bent as shown, the joint being soldered on the inside after securing, as before mentioned, with binding wire. Fig. 20 shows a side view of the box (Fig. 19), and the position of the hinge. For such purposes the pinned hinge (Fig. 21) is as good as any, and the most simple to make. Three or five pieces of tube are usually employed, two or three of which are soldered to one portion of the work, and one or two are soldered alternately to the other. The sections of tube when fitted together must form one connected length, a portion of wire being passed through the whole, so that the middle ones may move freely, supported by the pin through the two others. The pin is usually splayed at the ends to keep it from falling out.

Brazing.—Brazing is a very useful and, if properly done, reliable method of joining two pieces of iron. A brazed joint is considerably stronger than a soft-soldered one, and easily resists temperatures that would cause ordinary solder to run.

Brazing is not at all difficult if there is sufficient heat, and, for those who have no gas laid on, the use of an Ætna paraffin brazing lamp can be recommended. With this lamp, of course, the bellows is not used, and only an iron hearth with asbestos cubes is wanted; but gas should be used if available.

For satisfactory brazing, thoroughly clean the surfaces to be joined, first with a file and then with emery-cloth, and if necessary bind them together with thin iron wire. A flux of borax and water mixed up into a thick paste is smeared round the joint, which should then be warmed to get rid of the moisture. Spelter is either in the form of brass filings or a thin stick, and the latter is, perhaps, preferable, as the filings are apt to be blown from the work. Heat the metal to a white heat, dip the spelter into the borax paste, and apply to the part to be joined, rubbing round the joint until the brass is seen to run, when the heat can be cut off. Soft brass solder or spelter will be quite strong enough for most work, and consists of 1 part zinc, 1 part tin, and 6 parts brass melted together. The work should be almost covered in the asbestos cubes, and the spelter applied all round and not only in one place; failures to unite the parts mostly result from insufficient heat or cleaning of the parts. Brazing can be used to unite iron to iron, steel to iron, or steel to steel; cast-iron cannot be brazed. Brass solder—or spelter, as it is otherwise called—can be obtained from any cycle repairer, or from metal merchants.

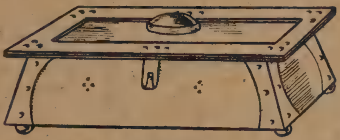


Fig. 18

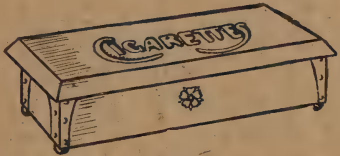


Fig. 19

Figs. 18 and 19.—Silver Boxes

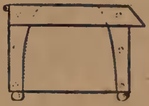


Fig. 20.—Side View of Box

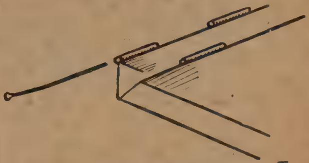


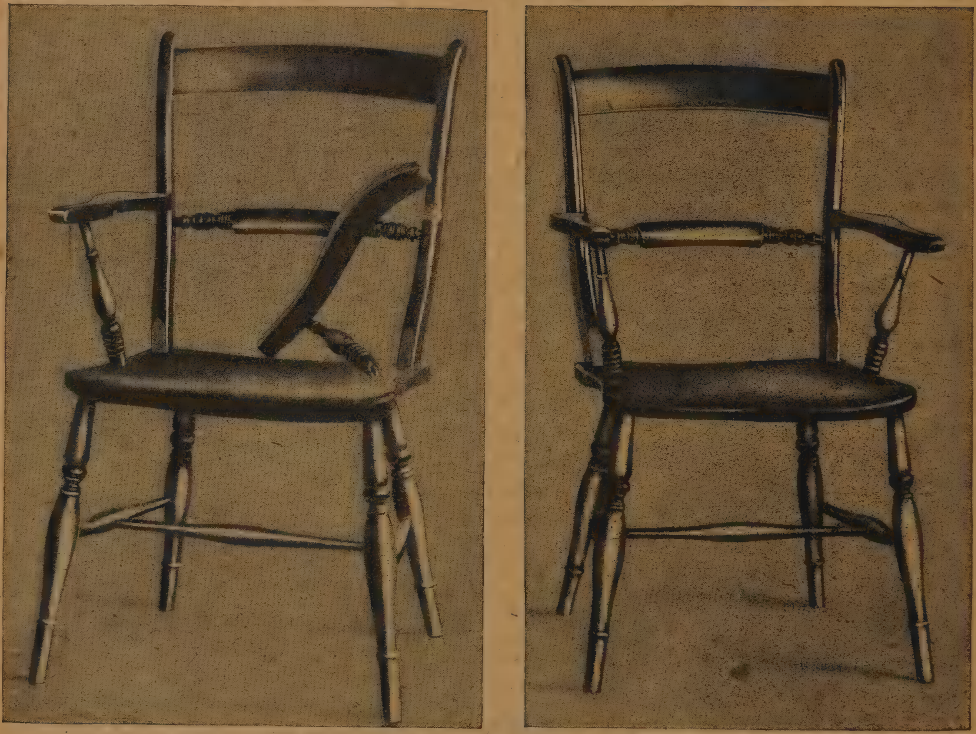
Fig. 21.—Pinned Hinge

To unite brass or very light parts not subjected to twisting strains or heat, soldering is mostly employed. Soft soldering is done with tinmen's solder, while hard soldering (which is next to brazing, but will only stand mild red heat) is executed with a solder that requires a blowpipe to melt it. These matters are fully gone into in other chapters of this work.

Chair Repairing

Repairing Kitchen Arm-chair.—Kitchen chairs are subjected to much hard usage, and when they get broken the sooner they are properly repaired the better.

Fig. 1 below shows one of the commonest breakages, and one that is often indifferently repaired. A somewhat similar case has been known to be sent out to be "mended" several times in the course of a year, at an expense ultimately amounting to more than the value of the chair. A workman is often told that "it only wants gluing," from which he infers that the repair is expected to cost very little; consequently he spends as little time over



Figs. 1 and 2.—Kitchen Arm-chair Before and After Repairing the work as possible, with the inevitable result that the repair does not last.

A sensible householder sees that furniture is repaired immediately the necessity arises; for one thing, the first breakage renders another one likely, and, in the second place, the repair is more easily effected while the fractured surfaces are still fresh.

With chairs of the make here illustrated, the back end of the arm is usually secured with a screw, and upon examination it will be found that the screw is broken in. To remove it, a cut needs to be made across the screw with a hacksaw, as in Fig. 3 (or a file could be used), so as to be able to turn it out with a screwdriver. The old screw may have been inserted in such a way that the thread part came across the joint, but in replacing with a new screw a slightly stronger and longer one is put in, so that it is the neck of the screw that comes across the joint (see Fig. 4).

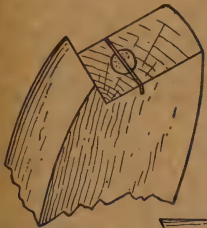


Fig. 3.—End of Chair, showing Saw-cut in Old Screw

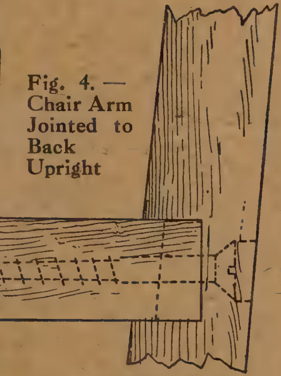


Fig. 4. — Chair Arm Jointed to Back Upright

As shown in Fig. 1, the spindle that supports the arm is broken off at the seat end in splinters (see also Fig. 5). It is tried in its exact position, and, when knocked up close with the hammer, the splintered parts are found to fit together quite neatly. Whilst being held in place (the back joint being secured with the screw to keep it steady) it is bored with a gimlet from underneath to take a 3-in. screw, care being taken to get the screw up into the centre of the spindle, as in Fig. 6. The two screws having been tried in their places are taken out and the joints parted for gluing.

The glue is quite hot and strong, and is regulated to the right consistency by adding boiling water. The screws and tools are placed ready to hand, and the four places to be glued are well warmed. The glue is applied and the parts brought together quickly and accurately, the screws being inserted immediately to bring the joints up quite close. The surplus glue squeezed out is wiped off with a rag wrung out in hot water.

The hole where the screw-head is sunk in the back upright should then be filled up with wood. For this and similar purposes the practical repairer keeps what are called "grain pins," these being pieces of wood turned to the shape shown by Fig. 7, the grain running across, not lengthwise. When glued in the hole they are easy to cut off and trim level. Take care to insert them with the grain of the wood in line with that of the chair upright (see Fig. 8), and they will then be almost unnoticeable when stained to match. If there are no "grain pins" at hand, the next best thing is to saw a bit of end grain stuff about 3 in. long by ½ in. square, to be rounded and tapered with chisel and rasp to fit the holes.

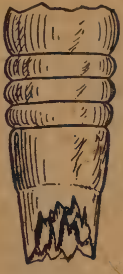


Fig. 5.—Splintered End of Turned Spindle

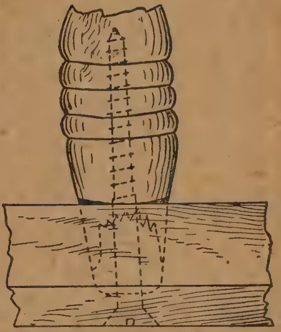


Fig. 6.—Spindle Screwed to Seat

The repaired chair (see Fig. 2) should be kept in a dry place for two or three days, and during that time may be used, providing it is not put to much strain.

After that time the chair will be found as strong as ever.

Repairing Bentwood Chairs.—Bentwood chairs are well adapted for light usage, but in course of time they are apt to get rickety, owing to the screws and bolts with which they are put together working loose. Simply to tighten up the bolts and screws is not a permanent remedy, as they will work loose again; and whilst in this condition, more serious breaks often occur, such as the screws breaking in the legs or the legs themselves getting broken off where they are let into the seat frame.

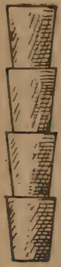


Fig. 7.—Turned "Grain Pins"

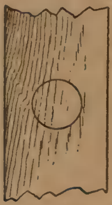


Fig. 8.—"Grain Pin" Covering Screw-head

To make a satisfactory job the chairs should be taken to pieces, and re-put together, using glue at every joint. To do this, the screws in the hoop rail below the seat must first be drawn, then the two bolts from the back legs and seat frame. The front legs should be marked before knocking them out of the seat frame, and may then be glued in exact. The hoop rail should next be glued and screwed in position to the front legs; then the back can also be glued, screwed, and bolted on. The chair should be left in a dry place for a day or so to set before being used.

When the bolts are bent they can be straightened with the hammer on a block of wood, so as not to burr the thread; but bent screws should be replaced by new ones. In some cases the screws will be found to fit the holes very tightly; this is a fault which makes it difficult to get the joint well up. They should be of a size to fill the hole and turn easily.

When a screw is broken in the leg it can be removed by boring it out with a quill-bit—not one sharpened to a point as used for making screw-holes, but more like a gouge, so that it will work round the screw. In re-screwing, larger screws will be required, or the holes must be filled with wood.

The re-caning of chair seats has been dealt with on earlier pages.

Repairing Old Mahogany Arm-chair.—The photograph (Fig. 9) shows a chair that had been lying in a heap for several years. It is of good Spanish mahogany and well-made originally, and it has well repaid the trouble of putting together again. In repairing this chair, a start is best made with the legs and lower spindles. To do this, the chair is turned upside down with the seat on a stool or bench and the holes cleaned out, free from old glue, with a gouge. The legs are then tried in place, and care taken that they fit well into their holes. The lower spindle joints are quite firm, but one of the side spindles is broken at each end. The ideal repair would be to make a new turned spindle, taking the good one at the opposite side as a pattern; but

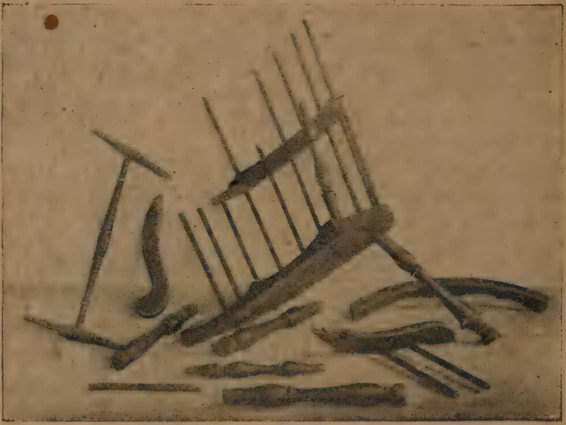


Fig. 9.—Old Mahogany Chair in Wrecked Condition

that may not be convenient to many home-workers, especially as the fixed joint would have to be undone at the risk of breaking another spindle; so it is assumed that the old spindle will be made to answer. At the back end it is broken off slant, leaving a few inches still firmly joined to the leg (see Fig. 10). It is decided to splice the parts together, but first the other end must receive attention. Here there is a somewhat similar breakage, but the short piece is missing. To join on a new piece, first the broken end is cut off up to the turned ring, and a hole bored in the end about $\frac{1}{2}$ in. deep; then a new piece of stuff is prepared with a pin to fit the hole, as in Fig. 11. Both the pin and the hole are next bored with a suitable gimlet to take a 3-in. dowel screw. The joint is tried together to see that it fits correctly, and also tried in place to fit the hole in the leg; all being well, it is unscrewed and put together with strong glue, which will considerably help the screw (see Fig. 12).

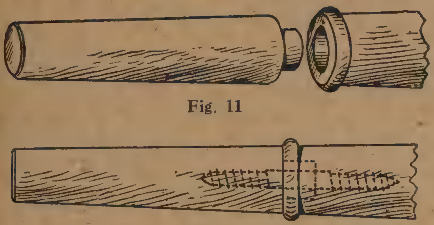


Fig. 11

Fig. 12

Figs. 11 and 12.—Jointing New End to Chair Spindle

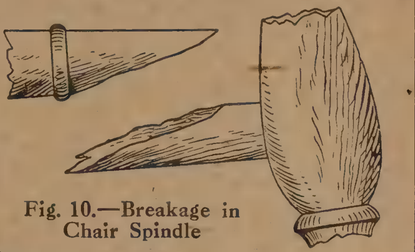


Fig. 10.—Breakage in Chair Spindle

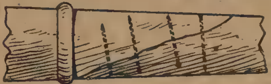


Fig. 13.—Spliced Spindle

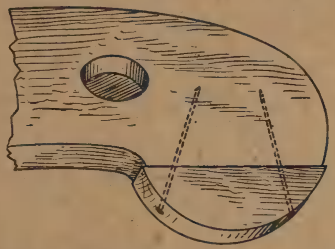


Fig. 14.—New Piece on Chair Arm

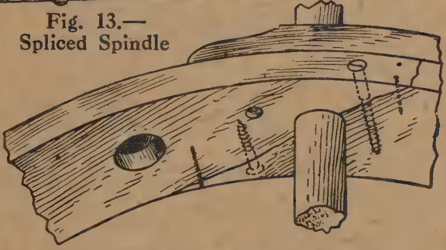


Fig. 15.—Repairing Chair Arm

The legs are now ready for gluing in place, which must be done in a warm atmosphere, and as quickly as possible, as there are several joints to be glued at the same time. It is an advantage to warm the parts to be glued, especially the jagged surfaces of the break shown in Fig. 10. The glue must be hot and strong, but not too thick. The mallet, hammer, fine bradawl, $\frac{3}{4}$-in. fine panel pins, and string must be convenient to hand. The insides of the holes in the seat and legs are glued first, next the ends to fit them, and they are finally brought together quickly and forced well up. The joint shown by Fig 10 is then glued on both jagged surfaces and pressed together to form a perfect fit, binding it with string and fixing with the fine pins, as in Fig. 13.

The chair can now be stood up for convenience in working on the upper part, taking care, however, to avoid unduly straining the freshly-glued joints. The left arm has a piece broken off at the circular end, and requires a piece of mahogany about 3 in. long by 1 in. wide to be jointed on. To do this, both surfaces must be made quite straight and must fit together quite close, the piece being then cut to the shape required, which is decided by marking from the other arm. Both surfaces are well warmed and glued, and rubbed together for a few seconds to work out the surplus glue, then stopped in exact position. This "rubbed joint" unites the wood fibres, so that when set it is as strong as any part of the wood itself. Before it is wholly set, secure it with two fine sprigs, as in Fig. 14, and afterwards trim the work to the correct shape.

The two plain spindles in the arm (shown in the photograph, Fig. 9) are a little loose and need to be taken out for re-gluing and for convenience in repairing the joint at the back of the arm; the same applies to the spindles in the seat under the right arm. The breaks of both arms are somewhat similar, and they are first fixed with screws, as in Fig. 15. Those that show from the front and back are sunk a little for the heads to be covered with "hard filling." When all is ready the gluing up is managed the same as described for the lower part, one arm being taken at a time. The screws should pull the joints close up, but where the wood tapers thin a few fine pins may be inserted.

The top back rail is next tried in place. There is one spindle broken off slant which will have to be repaired, as was the break shown in Figs. 10 and 13. It is tried in place while the back rail is on. The rail is then taken off to be put on with glue, the piece of spindle being then glued in place and bound with string, which is not removed till the joint is set, when the pins may be inserted. The glue may be wiped off the joints as they are made, with a rag wrung out in hot water, or picked off with a knife when partly set.

For filling up screw-holes or any other defects, a cement or "hard filling" (called by polishers beaumontage) is made by melting together about equal parts of beeswax and resin coloured to match the wood by adding a little venetian red and brown umber. It is run in hot from the point of a small bit of stick, and when cold it is scraped down level and rubbed over with glasspaper, when it will be quite unnoticeable.

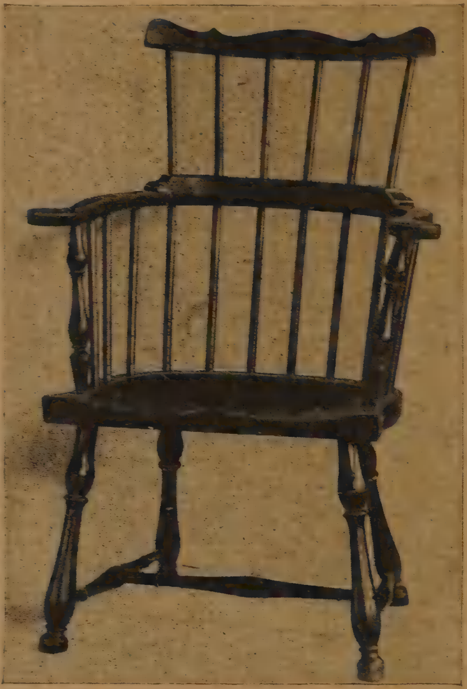


Fig. 16.—Mahogany Chair Repaired

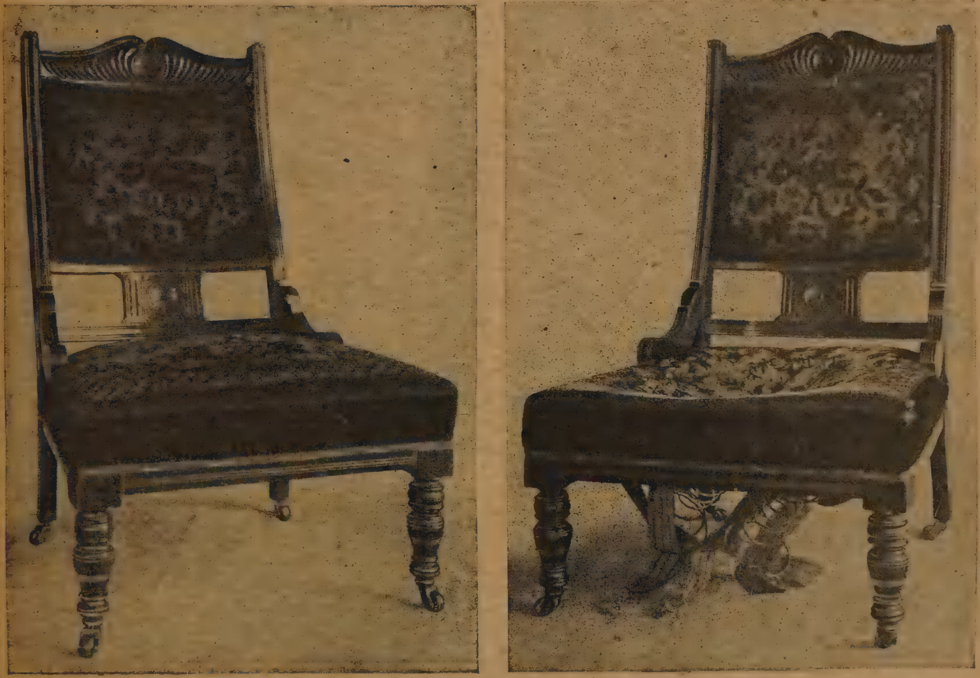
The chair is now quite strong and firm (see Fig. 16). Being of good mahogany, it will pay to clean it thoroughly with glasspaper, to repolish it, and to make a cushion for it. But if that course is not convenient, it might be lightly cleaned up and rubbed over with linseed oil, which is afterwards polished off with clean rags.

Re-webbing an Easy-chair.—A common failing in an easy-chair is the giving way of the webbed bottom. A very cheap chair might collapse after a year's use, whereas a thoroughly well-made chair might stand for fifteen years, or even longer. When a heavy person is in the habit of "dropping" into a chair, the webbing needs to be made extra strong. Fig. 18 shows a typical failure, and Fig. 19 shows the state of the bottom. Attempts have been made at repairing it by stitching the web and looping the springs with strips of canvas to keep them in place.

The method of repairing this chair, to produce the result shown by Fig. 17, is to turn it upside down, resting the front edge of the seat on perhaps a box to keep it level; spread a sheet over the floor to avoid scratching the woodwork. Strip off the old web with a blunt wood chisel and mallet in the manner shown by Fig. 20. It happens that the spring canvas is not broken, so (after brushing out the dust) the top coil of each spring is stitched to the canvas in the same place as the marks show. There are only three springs in this chair, and three stitches to each will be sufficient if done in the way shown by Fig. 21. A bent-point packing needle and thin twine are used. German web was on the chair, and the same quality is to be put on again; but there were only five lengths before, and an extra one had better be put on (see Fig. 22). The springs are shown sticking up through the webbing, but they are easily worked into position. They should be fairly upright, so that the weight will press the coils closer and not to one side, and they are stitched to the web in the same way as to the canvas (see Fig. 23).

A cover of canvas or black linen is neatly tacked over as a finish, and to keep out the dust. The seat is now restored to its original shape, the result being shown by Fig. 17.

Re-webbing Drawing-room Chair.—Fig. 24 shows another chair with a broken-down webbed bottom, but this requires quite a different treatment from one having springs. This is a good-class chair of uncommon design. The woodwork is of rosewood, tastefully inlaid, and, although it is not constructed on lines calculated for strength, the material is so sound and the joints so well made that the chair is quite rigid and strong. The



Figs. 17 and 18.—Easy-chair After and Before Re-webbing

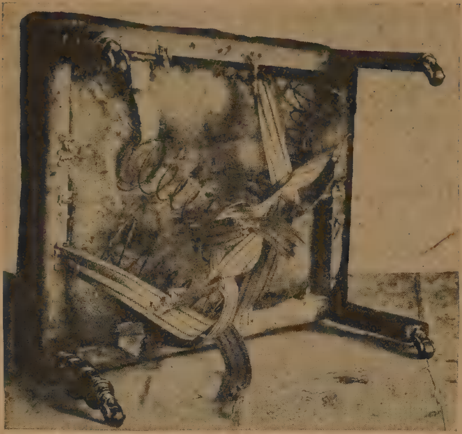


Fig. 19.—Bottom of Chair to be Re-webbed

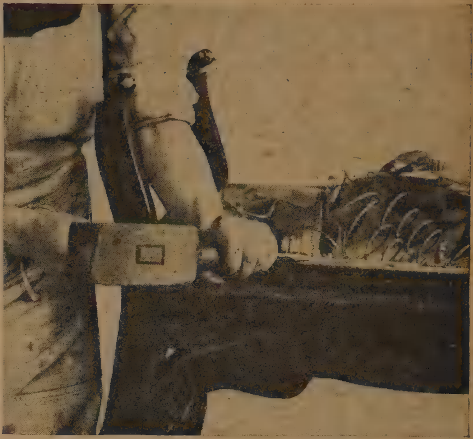


Fig. 20.—Stripping old Webbing

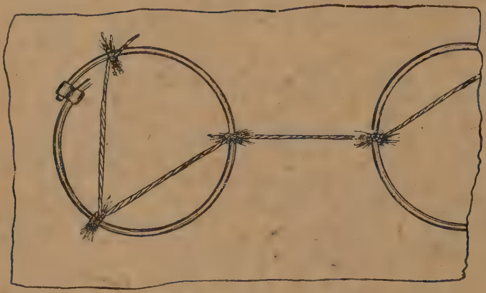


Fig. 21.—Springs Stitched to Canvas

stuffed work is light in character and is quite in good condition, as is also the crimson velvet with which it is upholstered, but it requires re-gimping, and the stitched seams also must be re-corded.

To re-web the bottom, the stuffed seat must be stripped completely off. First the velvet is carefully untacked, and, without lifting it off, the under-cover of calico and the "scrim" covering the hair stuffing is also untacked. It can then be lifted away altogether to get at the broken canvas and webs for the purpose of stripping them off.

The front and back seat rails are curved

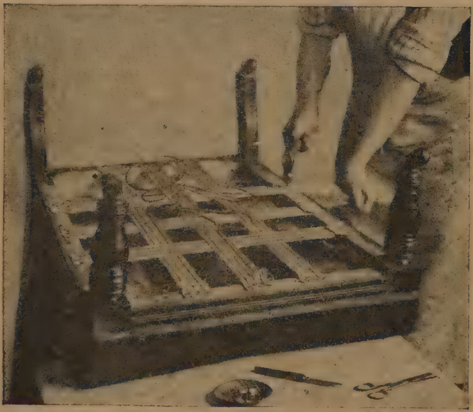


Fig. 22.—Stretching Webbing while Tacking

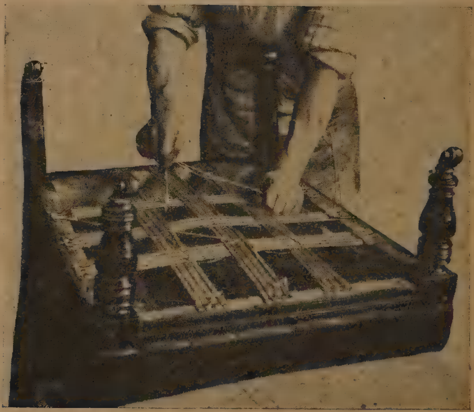


Fig 23.—Stitching Springs to Webbing

so, in putting on the new webs, begin by tacking to the centre of the front rail. English web is used, five from front to back and four across, the latter not being stretched so tightly as to take out the hollow of the seat (see Fig. 25). A piece of canvas or strong grey linen is then stretched tightly over and tacked on.

The stuffed seat, being all hair, is quite in shape and could be replaced, but whilst it is off it is as well to remove the velvet and calico to beat the dust out of the stuffing without breaking it up; afterwards tack it in place exactly as before. The velvet also is beaten and brushed before being replaced.

There are two corded seams on the top edge of the upholstered back; and the seams on the back end of the arms are also corded. The cord, being shabby, is taken off and replaced with new, which is laid in the seams and pins thrust through it into the stuffing to hold it in place whilst being stitched. This can be done with an ordinary sewing needle and strong thread of a colour to match; but an upholstress would use a small circular needle of the kind shown by Fig. 26. When finished, the pins are taken out and the cord should lie straight and firm in the seam, and no stitches should be seen. The front edges of the arms and round the seat are finished with scroll gimp fixed with fine, coloured gimp pins (see Fig. 27).

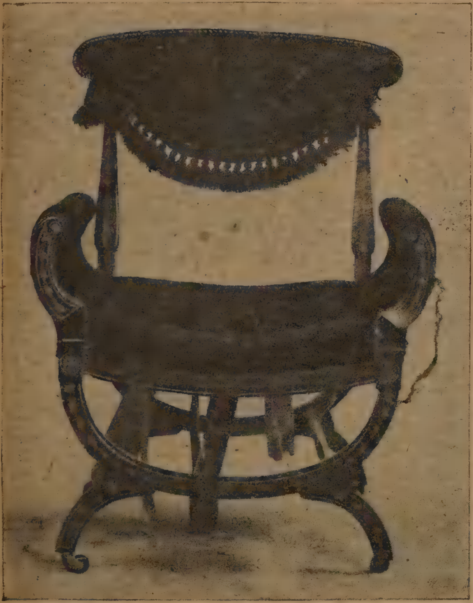


Fig. 24 —Drawing-room Chair before Re-webbing

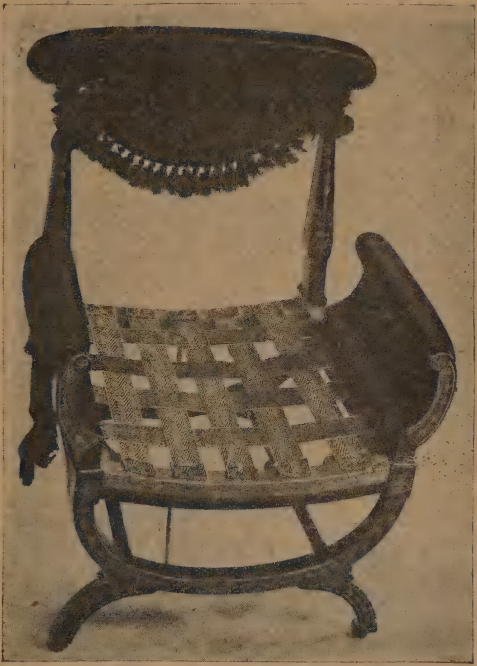


Fig. 25.—New Webbing on Chair

Repairing "Spoon-back" Dining Chair.—There are some forms of breakages, in chair frames particularly, that are considered very difficult to deal with. A case in point is illustrated by the photograph, Fig. 28, which shows a badly broken chair that cost four shillings to "repair," and did not last a month. Apart from any consideration of cost, it shows inefficient workmanship, as can be clearly seen in the photograph.

This chair is one of the six "smalls" of a nine-piece dining-room suite in pollard oak frames, treated with simple carving, and ebonised work, all well upholstered in a good quality green velvet, and all hair stuffed. It bears the name of a good class firm, and the suite must have cost at least £60 (pre-war). This style of chair is known as "spoon-back," but in many cases the top corners are rounded. The deep curve of the back is a good feature as regards comfort and appearance; but in this case it would have been a constructional improvement to have supported the back by a carved "splat," or spindles, between the lower back rail and seat, especially so as pollard oak is very cross-grained and curly in some parts, which, while giving beauty to the finished appearance, detracts from the strength.

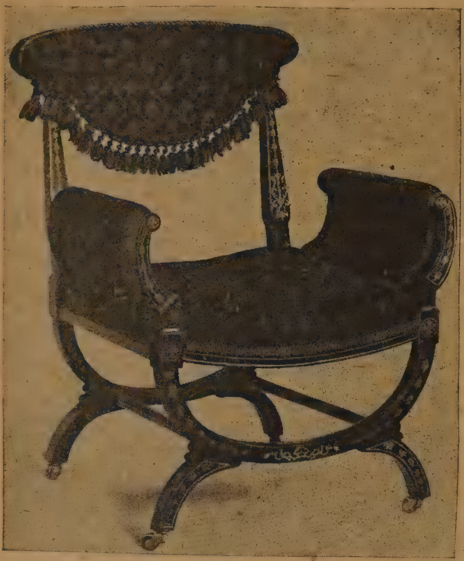


Fig. 27.—Drawing-room Chair after Re-webbing

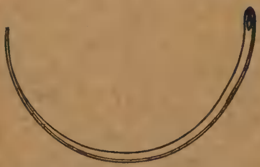


Fig. 26.—Upholsterer's Curved Needle

The previous attempt to repair was to glue the breakages together and screw on brass plates across at the back, see Figs. 28 and 29. One of the casters was broken off, the screw being in the leg. Instead of getting out the broken screw, a socket caster had been put on, but as the socket was too small, the leg was pared down, somewhat spoiling it, and causing the leg to be $\frac{3}{8}$ in. too long; this put a strain on the caster, and it was very soon off again (see Fig. 28), and that was fortunate for the seat frame, which otherwise would soon have become loose at the joints, owing to the twist.

A good workman may seem to be going a long way about the job, but he intends his work to stand for twenty years or longer (bar accidents), so he spends some time examining the job. Then he takes off the brass plates, some screws and nails which were in the way, and the other caster, so that the chair will stand steady to work on. The stuffed work is very much in the repairer's way, and being burst away from the woodwork at places and needing some new canvas, banding, and studs, it is well to strip it completely off, except the webbed and canvas bottom. Had the broken woodwork been fresh it would have been easier to make a good join, but now the glued surfaces have to

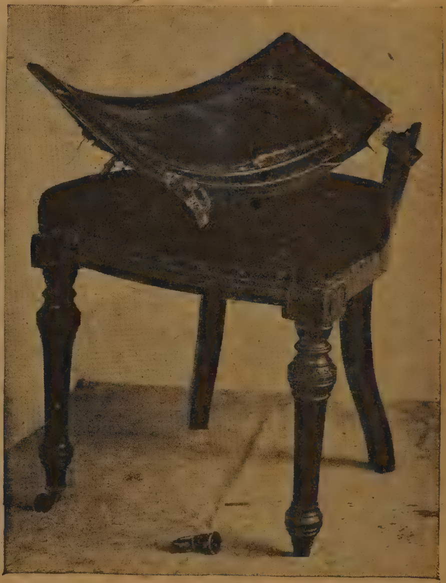


Fig. 28.—"Spoon-back" Dining Chair to be Repaired

be washed quite clean with hot water and a stiff brush, and left till quite dry.

There are three awkward breakages, and it is found practicable to repair the one shown by A A in Fig. 30 with dowels and glue; B, by gluing and the judicious use of fine sprigs; and C C, by gluing and sprigging, by inserting a long screw through the seat rail, and by strengthening with a glued block.

The breakage B in the lower rail of the back frame is the first to be put right. It is shown clearly in Fig. 31 with a nail between to prop it apart. In this position the broken surfaces are well warmed for gluing. The glue is quite hot, and is amply applied to both surfaces, which are next pressed together closely till the joint can hardly be seen, and then bound with string. The string is tightly wound round, and wetted to make it tighten further. The wood is then pierced with a fine bradawl at the most suitable places, and fine panel pins driven in, the heads being sunk a little below the surface with a fine punch (see Fig. 32) where is shown a small bit still missing out of the moulded rail. This is cut to an even shape with a $\frac{1}{4}$-in. chisel, and a bit of the same kind of wood is fitted and glued in, to be trimmed off when set, as Fig. 33 shows.

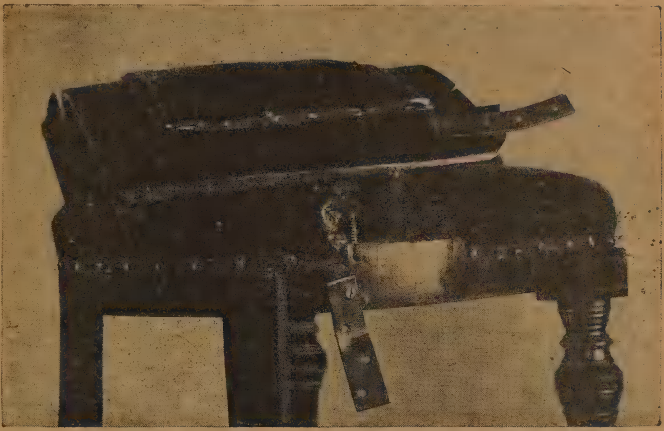


Fig. 29.—Remnants of Rough Attempts at Mending

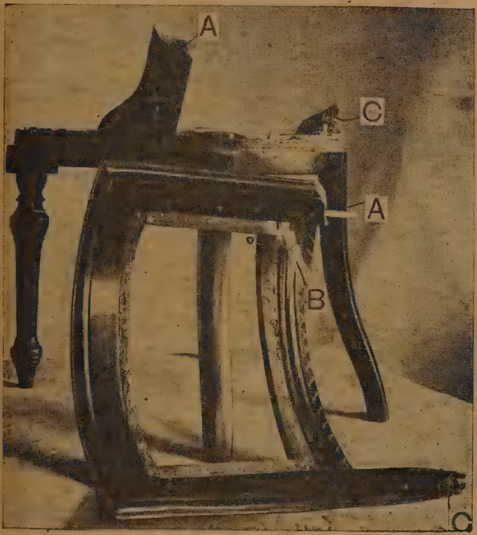


Fig. 30.—The Chair Stripped

To mend the breakage A (Fig. 30) the broken surfaces are tried together and found to fit fairly neatly. Being very uneven, it is hardly practicable to gauge for the dowel holes; but by carefully observing the grain of both the jagged surfaces, it is not difficult to decide the points for the dowels by the splintered appearance (see Fig. 34). Particular care is taken to get the dowels into the thickest part of the wood, and they are further tested for accuracy with a pair of dividers. The dowel holes ($\frac{3}{8}$ in.) must be bored quite straight with the wood. One dowel is put in first and the joint tried before boring for the other. Should it be correct, it will be a guide in boring the other two holes. The back frame is gripped in the bench vice at the break, resting the other part on a stool to keep it from slipping, and it is bored as shown by Fig. 35. The dowel is then put into the other half of the joint, which is bored as in Fig. 36. The other dowel is then put in, and the joint again tried.

Breakage C is to be repaired as shown by Fig. 37, so the joint is first bound with string, and the screw inserted; also the wood pierced ready for the sprigs; then the joints are taken apart for gluing. The broken surfaces are well warmed, and a warm position is chosen for "gluing up," which must be done as quickly as possible. The dowel holes of the back frame are glued first, and the dowels inserted, then the other holes and the surfaces of both joints, and all are got together as close as possible, tapping up the dowelled joint, then driving home the screw. The dowelled joint, being slant, is inclined to slip up a little too far, making it uneven; but to remedy this, a bit of wood is put across it on the front and back, and two small cramps put on (see Fig. 38), which presses it into exact shape. The other joint is bound close with string until set, then a block is well fitted, glued and sprigged as shown at D. The sprigs are also driven to secure the joint and punched a little below the surface. The cramps are taken off joint A, and suitable sprigs inserted from both front and back (see Fig. 39).

The work is done with such good effect

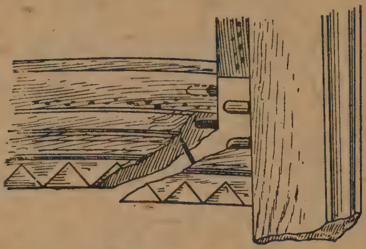


Fig. 31.—Broken Curved Rail

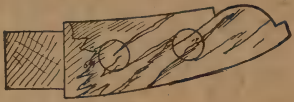


Fig. 34.—End of Broken Back Stile, showing Positions for Dowels

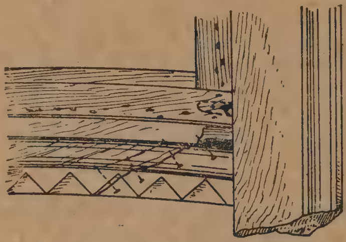


Fig. 32.—Broken Rail in Course of Repair

Fig. 35.—Boring Back Frame in Vice

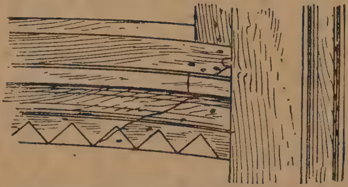


Fig. 33.—The Repaired Rail

that, when thoroughly set, the chair is as strong as ever; but owing to the joints having been previously tampered with, they are not quite so neat as they would otherwise have been, and they require a little filling, as do also the nail holes and the holes where the plates were screwed on. For this purpose, a cement is made by melting, in a large tablespoon, a piece of beeswax and a piece of resin, each about the size of a walnut. The wax is cut into flakes and the resin crushed to powder. A little yellow ochre is added, to colour it to match the wood. It melts readily to a thin, hot liquid, and is run into the crevices and holes from the point of a small bit of stick. It sets quickly, and, when trimmed level with the chisel and glasspaper, is unnoticeable. The slight rubbed appearance left by the glasspaper is remedied by rubbing with the linseed-oil rag.

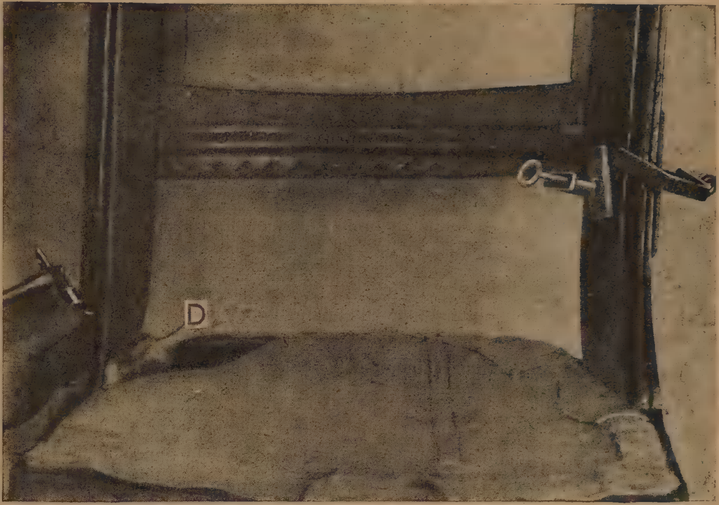


Fig. 38.—Cramping and Nailing Glued Joints

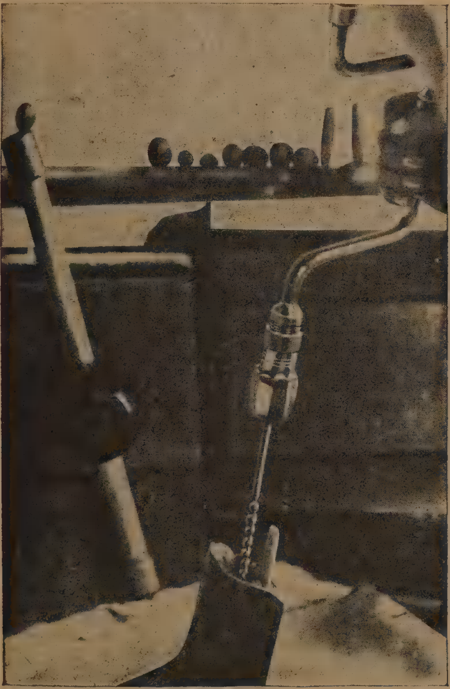


Fig. 36.—Boring Other Part of Dowelled Joint

The broken caster screw in the leg is next removed by using a gouge-shaped boring-bit in the brace to core out the screw (see Fig. 40). Then the hole is filled with wood glued in, and, when set, the new caster (to match the other one) and ring is put on.

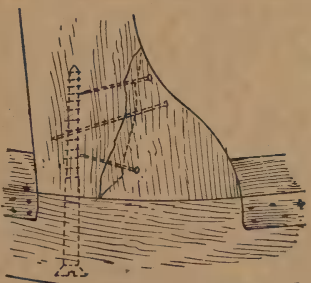


Fig. 37.—Repairing Stile Broken at Seat Rail

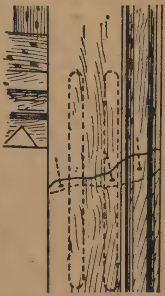


Fig. 39.—Dowelled Joint

The stuffed work of the back and seat is to be replaced as before, which can be traced by the tack marks, but new web and canvas are required for the back, and the dust is beaten out of the hair without breaking it up. The velvet also is beaten and well brushed before being tacked back, and the edges are finished with new banding and studs; with the result shown by Fig. 41. Readers should compare Fig. 28 with Fig. 41, and will, it is thought, admire the skill of the craftsman in restoring what appeared to be a hopeless wreck.

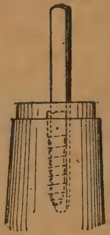


Fig. 40.—Boring Out Old Caster Screw

Some cabinet-makers have strong objections to the use of nails in repairing and making furniture, and rightly so to some extent; but the objection is sometimes carried to a foolish length, limiting the possibilities of the restorer's work. In some first-class shops it is difficult to find a nail in the place. Amateurs often do more harm than good by trying to mend furniture with nails; but the fault lies in using the wrong nails in a wrong way. Round, wire nails with small heads, known as panel pins, are extremely useful to give additional strength to glued joints; but it is chiefly the uniting of the breakages with the glue that must be depended upon. It may be said that with good-class furniture, to avoid the use of nails altogether, new parts could be put in. That would mean, in the case just dealt with, taking the back frame to pieces, splicing new pieces on the two stiles and curved rail, and making new dowelled joints, or making a new rail and stiles complete. To do this, the same kind of wood must be obtained, and there is a considerable amount of work to be done, the cost being twice or thrice that for doing the work in the way here described.

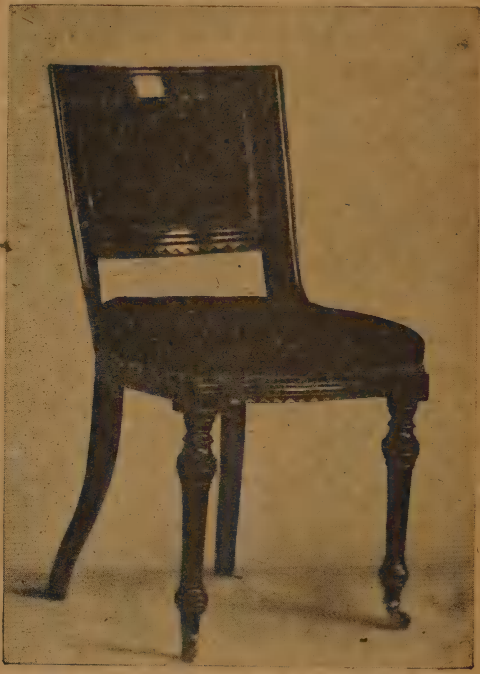


Fig. 41.—"Spoon-back" Chair Repaired

Soapmaking at Home

MANY amateur mechanics will consider that soapmaking is certainly not within their province, and may question the wisdom of including this chapter in a general treatise on handicrafts; but the Editor has had so many requests from amateurs for information and definite first-hand instruction on the subject that he has thought it desirable to present a concise chapter on the subject from the pen of an experienced chemist.

MAKING COLD-PROCESS SOAP

This method is the only one suitable for making soap at home, the utensils required being simple and few in number. The best fats to use are kitchen fat, with more or less cocoanut oil and cottonseed oil.

Making a Small Quantity of Hard Soap.—For making a few pounds of soap, the only apparatus required is a large pan for heating the oil, an earthenware bowl for mixing, a wooden spatula for stirring, and a well-made wooden box to act as a mould.

The following proportions may be used in making 9½ lb. of good hard soap: (1) Cottonseed oil 3 lb., cocoanut oil, 3 lb., caustic soda 1 lb., and water 3 pt. Or, (2) Kitchen fat 2 lb., cocoanut oil 2 lb., cottonseed oil 2 lb., caustic soda 1 lb., and water 3 pt.

The fats should be heated to about 130° to 140° in the pan, and then poured into the bowl (all temperatures mentioned in this chapter are Fahrenheit). The caustic soda should be dissolved in the water, the temperature of the lye being about 50°. When the temperature of the fat has fallen to about 130°, the lye should be poured into it very slowly, the fat being constantly agitated with the stirrer, so that the lye becomes perfectly incorporated with it. If any of the lye falls to the bottom of the bowl, it will be difficult to get it to mix subsequently; therefore the utmost care is required at this point. The temperature of the mixture should not be below 105° or above 150°.

The mould should now be prepared by wetting a cotton cloth, and placing it inside the wooden box, so as to cover the whole of the inside. The mixture of fat and lye should then be poured in and the box covered. The saponification at a low temperature takes place gradually; therefore the mould and its contents should be covered up and kept in a room of about 70° to 80°, at which heat the operation will be completed in twenty-four hours. The soap may then be turned out and cut up with a wire. During saponification, the temperature rises spontaneously to about 76°.

Making Hard Soap in Quantity.—The plant required for the manufacture of "cold-process" soaps on a larger scale, that is, up to about 1 cwt., consists of a pan for heating the fat, for which purpose a washing copper will serve all requirements. A mixing vat will also be necessary. This consists of a large wooden tub or half barrel, to which is fitted a stirring gear composed of a series of wooden arms fixed to a central piece of wood made up of two pieces of hollow wood and bolted to a vertical iron spindle. The spindle revolves in a bearing in the cross-piece at the top, and in the step plate at the bottom of the vat. It is caused to revolve by two bevel wheels and a horizontal spindle, to which is attached a hand-driven wheel similar to those used on wringing machines. The cross-piece is held in position during use by lugs at each side, which interlock with corresponding lugs on the outside of the vat, and thus prevent it moving when the blades are in motion.

The heated fat should be delivered into the mixer from the pan, and the lye run in slowly from a lye tank fitted with a tube and cock for regulating the supply. During the addition of the lye the paddles should be kept constantly moving, so that the mixing may be perfectly complete. The mixed fat and lye is run off from a valve at the bottom of the mixer.

The moulds are made in pieces, the bottom being grooved all round so as to take the sides, which are screwed or bolted together, while the top is a plain piece of wood simply laid on. To prevent the soap sticking to the moulds, it is usual to line them with a wet cloth. When the soap has set hard, the cover is removed and the sides are raised, leaving the block of soap on the bottom of the mould. After allowing to dry for a day or two in the air, the soap can be cut into bars by means of a thin steel wire.

Densities of soap-making lyes are tested with a hydrometer, of which two kinds, the Beaumé (B.) and the Twaddel (Tw.), are in use. The relations between these and specific gravities are fully set out on a later page.

The lye used is strong, usually about 36° B., and in amount is exactly half the weight of the fat; thus 100 lb. of fat requires 50 lb. of lye, this being equal to 14·9 per cent. of caustic soda. The soda in these soaps is in excess, and they are consequently rather alkaline; the glycerine and impurities are also retained.

The following examples may be taken as typical for the making of soaps by the cold process, the quantities being calculated for 100 lb. of fat or oil, other than cocoanut: (1) Fat or oil, 100 lb., caustic soda lye 50 lb., at 36° B. (2) For a white curd soap 50 lb. of lard, 50 lb. of fresh beef tallow, 50 lb. of caustic soda lye at 64° Tw. After mixing, stir in 8 lb. of water and pour into frames.

Making Mottled Soap.—A mottled soap may be made by the cold process by employing 7 lb. of cocoanut oil and 3 lb. of cottonseed stearin. These are heated in a jacketed pan to 70° in summer, or 85° in winter, then run into a mixer, and 9½ lb. of a cold caustic soda lye of 65° Tw. crutched in. The mixture is then run into moulds, and ultramarine or red oxide of iron, mixed wth a little oil, is stirred into the soap by means of a narrow sheet-iron frame, leaving it in wavy lines. The moulds are then covered up, and allowed to rest until the soap is fully formed. The alkali in this soap is in considerable excess, so that it will be a strong cleanser.

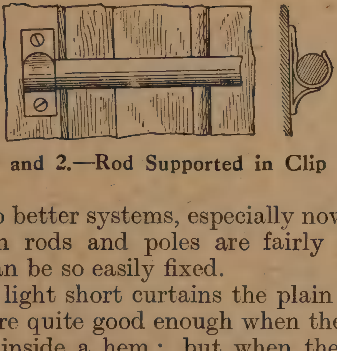
Making Shaving Soap.—In the manufacture of shaving soaps by the cold process, a certain proportion of the soda is sometimes replaced by potash, as this renders the soap more soluble and increases its lathering properties. The following are three examples of this kind: (1) Tallow 9 lb., cocoanut oil 1 lb., caustic-soda lye 4·4 lb. at 72° Tw., caustic-potash lye 5·5 lb. at 72° Tw. (2) Tallow 7 lb., lard 1 lb., cocoanut oil 2 lb., caustic-soda lye at 71° Tw., caustic-potash lye 12 lb. at 60° Tw. (3) Tallow 8·4 lb., cocoanut oil 18 lb., caustic-soda lye 4·2 lb. at 71° Tw., caustic-potash lye 1·25 lb. at 60° Tw.

The soaps made by the cold process contain excess of caustic soda, impurities from the alkali used, and the whole of the glycerine produced by the decomposition of the fat; hence they cannot be regarded by any means as pure.

Curtain Fittings

THE heavy, expensive, and elaborate window hangings of the Victorian era having been fortunately superseded by a much more simple style of decoration, the massive cornices and curtain poles of the last century are now in but small demand, and the window curtains of today are hung upon slight rods of either wood or metal.

With the humbler class of homes the practice of tacking curtains to the window framing or suspending them on strings is still too often followed, but it is giving way to better systems, especially now that curtain rods and poles are fairly cheap and can be so easily fixed.



Figs. 1 and 2.—Rod Supported in Clip Hooks

For light short curtains the plain wood rods are quite good enough when they are to go inside a hem; but when they are to be seen, as when rings are used, the enamelled rods are better. Where to screw on the simple clip hooks is shown by Figs. 1 and 2.

Brass rods are often preferred for appearance as well as for strength, and they require the " socket fixings " shown by Fig. 3 (or the cheaper but weaker hook shown by Fig. 4). The $\frac{3}{8}$-in. diameter rods are suitable up to about 4 ft. in length; but above that they usually need supporting in the centre by means of a cup hook (see Fig. 5). (This method is often adopted in draping the back of a piano.) When there is no convenience for a centre hook, a stronger rod should be used. The rods for these purposes are brass-cased iron tube, sold in lengths of about 14 ft. for cutting up, which may be done with a hack-saw or a three-cornered file. As they are lacquered they may be easily kept clean by simply rubbing with a soft cloth to keep free from dust or damp, a common mistake being to clean the rods with something that removes the lacquer protection.

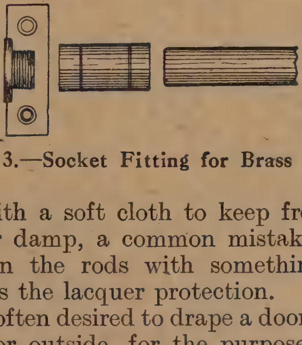


Fig. 3.—Socket Fitting for Brass Rods

It is often desired to drape a door, either inside or outside, for the purpose of excluding draught. For this purpose, the rods may be of brass, wood, or bamboo (preferably brass of $\frac{3}{4}$ in. to 1 in. diameter), and will require rings, ends, and brackets. For convenience in fixing, the brackets are mostly screwed at the top corners of the door framing; but to be more effective in preventing draught the rod should be above the door as shown by Fig. 6, and for this the wall must be plugged; the curtains should be of rather heavy material, and when not in use may be drawn back behind the door. This method is more effective than the portière rod (Fig. 7), which is the recognised thing for the purpose, and has the advantage of working automatically when the door opens. Portière rods vary in pattern, but most of them work on the principle of that shown in Fig. 7.

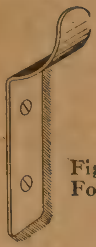


Fig. 4.—Cheap Form of Hook

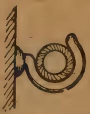
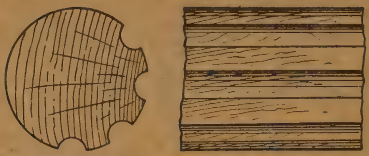


Fig. 5.— Rod Supported by Cup Hook

Curtain poles are to be bought in a number of stock sizes and in many patterns, for flat windows only; for bay or bow windows they have to be made. The material varies between 1 in. and 3 in. in diameter. Special material is made in long lengths for poles over 6 ft., or for cutting-up purposes, with fittings to match; but in making a bay window pole it is often more economical to cut up two or more of the straight stock sizes. These are from 4 ft. to 6 ft. in length, fitted with a pair of "ends" (ornaments), a pair of brackets, and eight, ten, or twelve rings. Metal fittings are often supplied with certain kinds of wood and bamboo poles, some of the very cheap ones being of such a thin gauge of brass that they are very easily damaged; and they soon tarnish. The wood fittings are to be preferred to even the better makes of brass—especially those of hard wood, which are inexpensive and very durable. They are of birch, beech, sycamore, or maple, stained and polished to imitate walnut, oak, mahogany, etc., and mottled to match bamboo. A bamboo or hardwood pole and fittings will serve for an indefinite period, and might only need an occasional cleaning. Besides the stained and polished poles, there are the white reeded, white enamelled, white and gold fluted, walnut and gold fluted, and ebonised and gold fluted. Often the flutes are only on the side that shows inside the room (see Figs. 8 and 9), and are gilded and burnished.


Figs. 8 and 9.—Fluted Curtain-pole

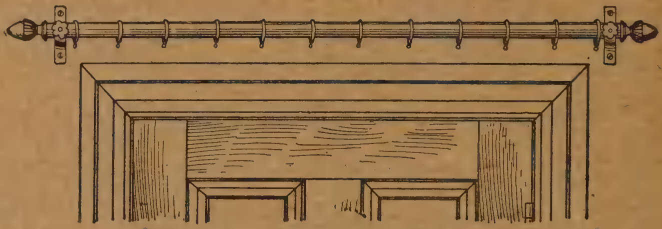


Fig. 6.—Curtain Rod Over Door

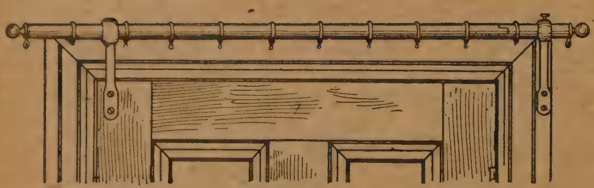


Fig 7.—Portière Rod Over Door

The sizes and angles of bay windows vary considerably, and the poles have to consist of three, five, seven, and sometimes nine pieces, as will be seen from the diagrams presented by Fig. 10. There are various ways of jointing the poles. Often they are nailed together in a slipshod manner, which, as the poles are high up in the room, is not readily noticed; but a fairly good nailed joint can be made as shown by Fig. 11, with three 3-in. wire nails. Holes must first be bored with a fine gimlet and then countersunk for the heads. Glue should be applied to the surfaces and the two nails driven first, then the other one driven in between the two. A more reliable joint is shown by Fig. 12; this is first put together with a 3-in. dowel screw, and then bored with a dowel-bit to receive a glued-in wood dowel. An old-fashioned form of joint (and a very good one) is shown by Fig. 13. It is bolted together, the nuts being let into the wood from the face, and a screw inserted to keep the joint from shifting. The advantage of this joint is that the pole can be taken to pieces; but it is a considerable trouble to make an eight-joint pole in this way, and sometimes the smaller pieces are put together with simpler joints.

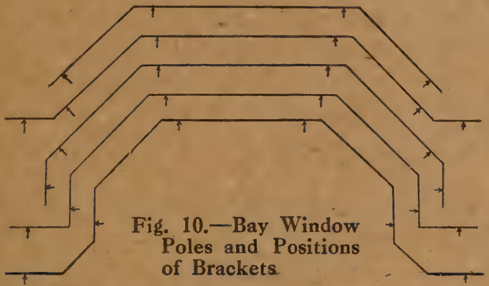
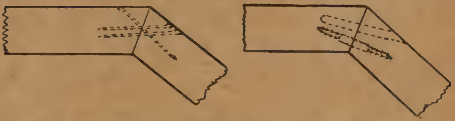
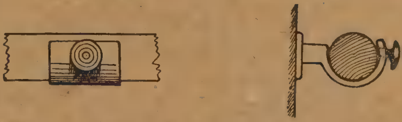


Fig. 10.—Bay Window Poles and Positions of Brackets


Figs. 11 and 12.—Methods of Jointing Bay Window Poles


Figs. 16 and 17.—Centre Bracket for Curtain Poles

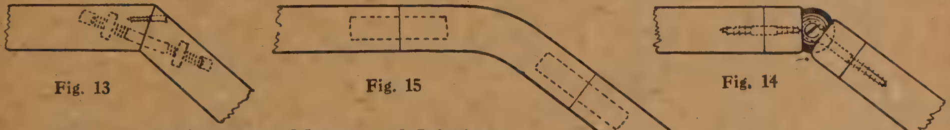


Fig. 13

Fig. 15

Fig. 14

Figs. 13 to 15.—Three Methods of Jointing Bay Window Poles

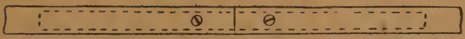


Fig. 18.—Straight Joint in Brass Pole

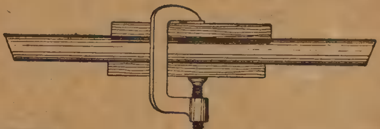


Fig. 21.—Pole Cramped for Sawing

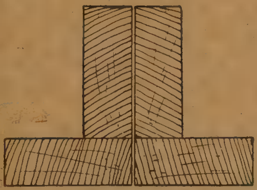


Fig. 20.—End Elevation of Blocks for Cutting Mitres

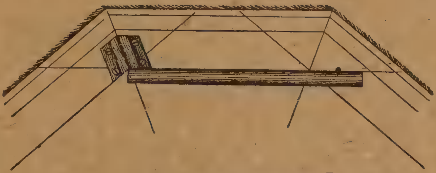


Fig. 19.—Setting Out and Cutting Mitre Joints

The hinged joint (see Fig. 14) is a manufactured article, in wood or metal, which is very popular because it will fit any angle and is much less trouble to make than a mitred joint. It is useful for poles intended for supporting lace curtains or curtains not to be drawn, because, the joints not being rigid, more brackets for carrying the pole are needed. The approximate points for these are about 3 in. from the ends of the pole and from the angles, as indicated by the arrowheads in the diagrams (Fig. 10); but when the joints are perfectly rigid three brackets only are often sufficient—the two end ones and one exactly central—this being particularly convenient with curtains that are to be drawn closed and open.

A convenient system is to have light casement curtains on the usual rods and fittings for the purpose, and a pole with heavier curtains that draw. This usually necessitates rounding the corners off the angles to allow the rings to pass; but better still is to adopt the method shown in Fig. 15, a solid piece of wood being cut to the correct angle, rounded to the section of the pole, and dowel-jointed. The centre-bracket should be of the kind shown by Figs. 16 and 17; and with all brackets the ornamental set-screw should be screwed up to fix the pole.

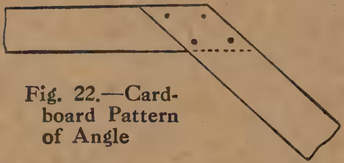


Fig. 22.—Cardboard Pattern of Angle

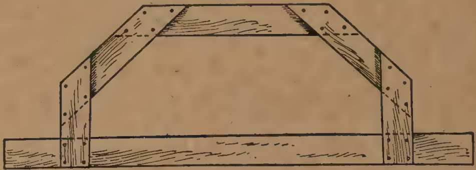


Fig. 23.—Template for Seven-piece Rod

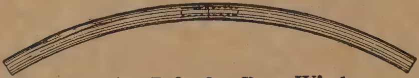


Fig. 24.—Pole for Bow Window

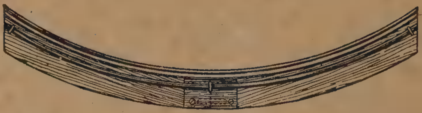


Fig. 25.—Underneath View of Cornice for Bow Window

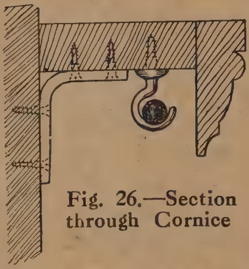


Fig. 26.—Section through Cornice

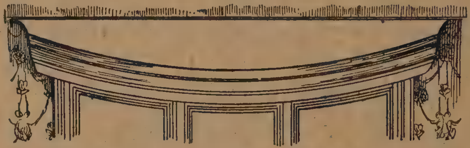


Fig. 27.—Upper Part of Bow Window

Curtain poles of brass may have the joints made in wood in any of the ways shown, the wood being worked in the solid about a foot in length to fit inside the brass tube. Or if, instead of the brass-cased iron tube, all-brass tube is used, it may be bent to such an angle as that shown by Fig. 15, the job demanding great care to prevent "kinking." One way is to fill it up with a piece of round cane, and assist the bending by heating the part in the flame of a spirit lamp. Another way is to push in a wood plug and fill either with sand pressed in or with a mixture of resin and wax melted and poured in. In making an all-brass pole with bent angles, two or more pieces of tube are used and joined together by filling with wood, the joint occurring about the centre of the straight part; and it is fixed by drilling holes in the brass and inserting screws (see Fig. 18).

The connecting wood should be as long as possible to increase the rigidity of the pole, as the all-brass tube is rather soft and apt to get out of shape if the curtains are heavy.

The measurement for a bay window curtain pole may be taken in most cases at the skirting board, as this generally stands out from the wall at the same distance as the window framing (about $\frac{3}{4}$ in. to $1\frac{1}{2}$ in.) to which the brackets are screwed; and it is sometimes convenient to make the pole on the floor of the bay in the manner shown by Fig. 19. It must first be ascertained how far the brackets will hold the pole from the window framing; the distance will be from 1 in. to 2 in., according to the size; and lines may be drawn on the floor that distance from the skirting board, to show the outer line of the pole, and other lines may then be drawn to show the inner outlines. Further lines are then drawn about 1 ft. from and exactly parallel to the skirting board, finally drawing the lines from the angle points, these being the guide lines in cutting the joints true.

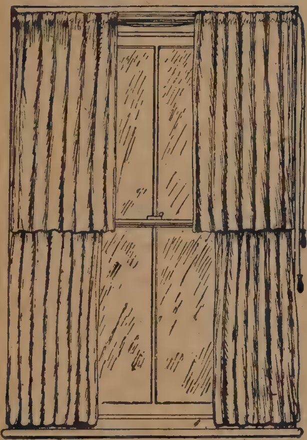


Fig. 28.—Window Fitted with Plain Casement Curtains

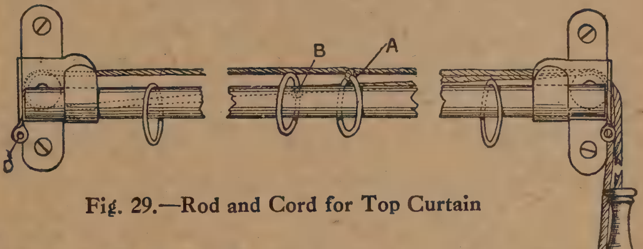


Fig. 29.—Rod and Cord for Top Curtain

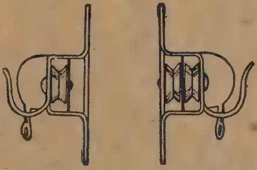


Fig. 30 Fig. 31

Figs. 30 and 31.—Fittings with Single and Double Pulleys

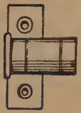


Fig. 32.—Socket Fitting

The stuff for the pole may be cut a little longer than the outlines drawn nearest the skirting board; and in the case of a three-piece pole, about 3 in. is allowed on the side pieces, past the bracket on the edge of the window framing.

For cutting the mitres, two blocks are screwed to the floor at each side of the angle line, as in Fig. 19. They are simply pieces of wood about 6 in. by 3 in. by 1 in., glued and nailed or screwed together at right angles, and cut slanting at the ends; but they must be square with each other (see Fig. 20), and must be fixed accurately with just sufficient space for a tenon saw to run between them. In Fig. 19 the front length of pole is shown in position for cutting the mitre, with a nail in the floor against which to rest the other end. The left-hand side length is cut, and the blocks and nails are then shifted to cut the other mitre. Both mitres must be true with each other, and, as the stuff is apt to turn whilst being sawn, it is sometimes advisable to cramp a piece of wood at each side of it in the manner shown by Fig. 21.

When it is not convenient to make the pole on the door, the measurements are taken, and patterns of the angles made by tacking together strips of cardboard (see Fig. 22); then the design of the pole may be struck out on a bench top. For a three-piece pole, the cardboard patterns serve the purpose fairly well; but a surer method, especially when the pole is of many pieces, is to make a template with thin wood laths, fixed together with fine wire nails or screws. Fig. 23 shows a template for a seven-piece pole.

For bow-shaped windows poles may be made in wood, in two or more pieces, cut from the solid and then rounded. For one to be made in two pieces, a half template may be used for marking out the two sweeps on the wood, one inside the other. They may be cut on a machine band-saw or with a hand bow-saw, and rounded with a plane and spoke-shave and jointed (see Fig. 24).

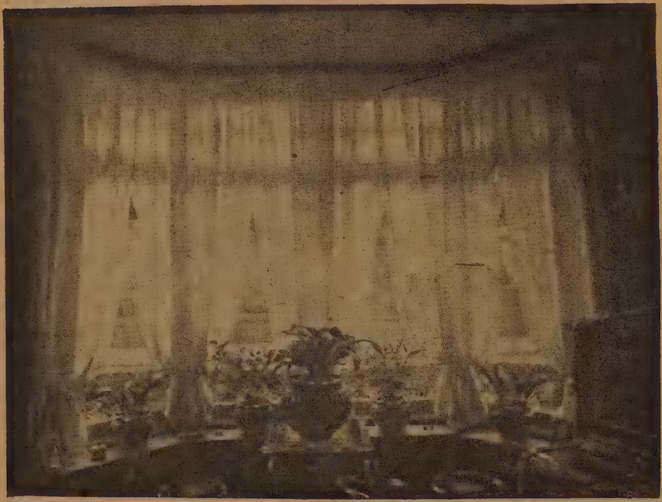


Fig. 33.—Bay Window Draped with Five Curtains on a Brass Pole

Another way of treating a bow window is by means of a cornice. Elaborate, expensive cornices are now out of fashion; but simple ones may be made at no more cost or trouble than a pole (see Fig. 25). Two sweeps of wood are cut, about 4 in. wide by 1 in. thick, and joined together in the centre with two $\frac{3}{8}$-in. dowels; to give extra strength, a thin piece is glued and screwed across the joint. A piece of moulding is then nailed on the inner curved edge, and will bend to the shape if it is straight in the grain and not too brittle. The curtain rod is of $\frac{3}{8}$-in. iron; it is easily bent to the curve, and hangs in three cup hooks. The cornice is fixed in place on four ordinary iron angle brackets (see Figs. 26 and 27). The rod may be supplied with brass wire rings; and instead of the moulding, a rod fitted on the edge to take a short valance.

Fitting Casement Curtains to Windows.—The system shown by Fig. 28 is plain, simple to understand, and convenient. The illustration shows an average window measuring 6 ft. 6 in. by 4 ft. over all, fitted with two pairs of short curtains, all four measuring 3 ft. by 3 ft., this being the measurement from the top of the lower sash to the ledge and the width of the stuff. A plain hem 2 in. wide is sewn on the top and bottom edges, so that they can be put up either way.

Fig. 29 shows the necessary rod and fittings to be fixed at the top of the window framing. The rod is of $\frac{3}{8}$-in. brass-cased tube with one and a half dozen rings. The fittings are supplied with pulleys for the cord, the left-hand one single, the right-hand one double (see Figs. 30 and 31). When they are screwed in place the rod with the rings on is put into the supporting hooks. The cord is then passed over the back pulley of the right-hand fitting, then over and under the left-hand pulley, and over the front right-hand pulley. The front end of the cord should hang at the side of the window within easy reach, and the back end about 2 ft. lower. The two centre rings should be put together in the centre of the rod, the cord drawn out from the front pulley, knotted to the right-hand ring, as at A in Fig. 29, and replaced. The cord is then drawn out of the back pulley, knotted to the left-hand ring, as at B, and replaced. The curtains are then fitted with the pins, and hooked in place on the rings, the outside ones to the eye C of the fittings. By pulling the front cord both curtains are drawn open, and by pulling the back one they are closed.

For the lower curtains the rod and rings are the same; but the ordinary socket fittings (Fig. 32) are oftener used.

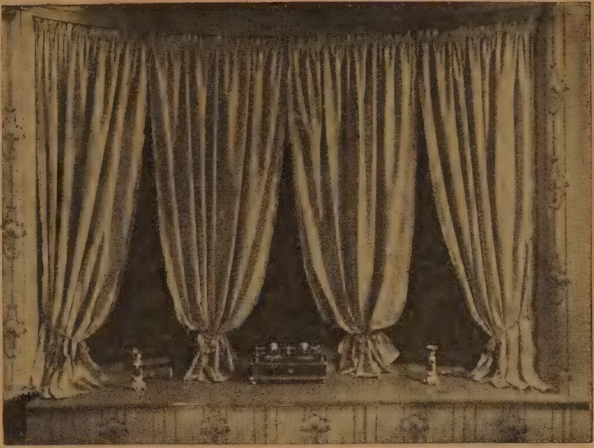


Fig. 34.—Casement Curtains in Bow Window

Casement-cloth curtains are also used, instead of lace curtains, for the ordinary method of draping windows from cornice poles. Fig. 33 shows a bay window draped with curtains hanging from a brass curtain pole, and Fig. 34 a bow-shaped window fitted with cornice and rod.

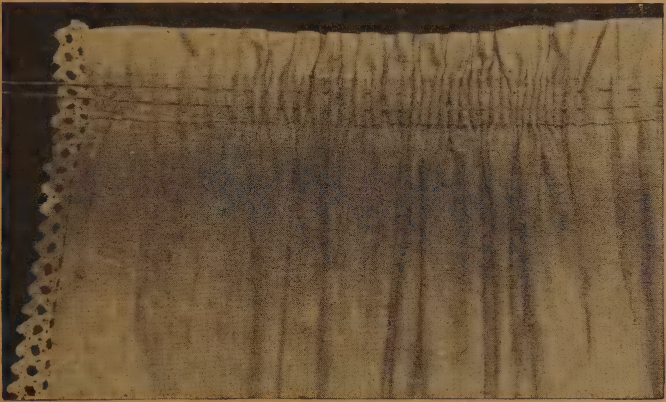


Fig. 35.—Head of Curtain Gathered on Special Tape

The gathered heading is much to be preferred to pleating with curtain pins; but some find it troublesome to make an even gathering and to stitch on the heading tape. A fixed heading is also not so easy to wash and iron as a plain one. There is now, however, a special gathering tape which overcomes these objections. It is shown in Fig. 35, and it will be seen that, by drawing the strings, the curtain can be gathered to any degree of fullness and drawn out straight again for washing. Fig. 36 shows the right side of the curtain fully gathered.

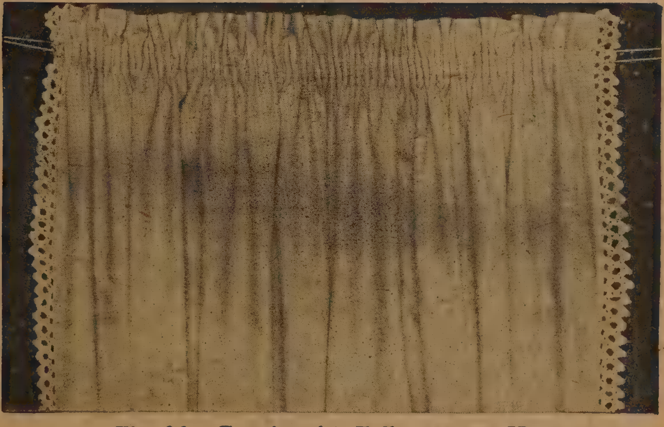


Fig. 36.—Curtain with Fully-gathered Head

Files and Scrapers: Using Them on Metal

The art of filing can be acquired only by constant practice and the experience gained in making mistakes. Most work that is filed is held in a vice, which should be fixed securely on a bench in a good light and at a suitable height, that is, level with the elbow when standing (see Figs. 1 to 2A). The vice must be adapted to the class of work for which it is required—whether model work, sheet-metal, or the running repairs of a motor-cycle or small car. For model work, one of the small parallel vices forged in wrought iron with hardened steel jaws, as used by clockmakers and machinists, is recommended, but one should beware of the cheap imitations in malleable cast-iron. For larger work, such as cycle and motor repairs, an engineer's vice of the instantaneous grip variety with a quick-release clasp nut is the best. A blacksmith's leg vice of the same width and opening of jaw is also a handy tool. In addition, the small bench vice will also be required, as there is much variety in size and shape of the articles to be dealt with in the average amateur engineer's workshop.

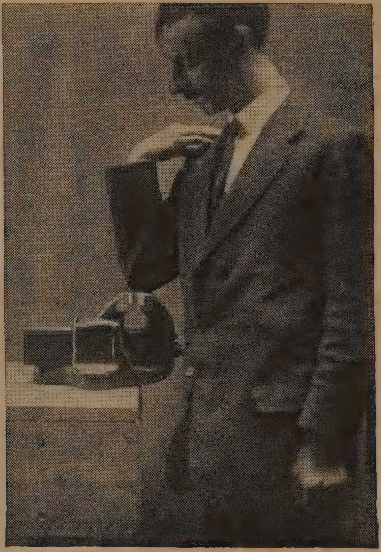


Fig. 1.—Finding Correct Height of Vice

With regard to the selection of files for model work, the following flat files will be necessary: One 10-in. parallel-edged flat bastard (next grade finer than a rough); this file has one "safe edge," that is, a smooth edge without teeth; one 7-in. safe-edge flat second cut (a grade finer than the bastard cut); one 7-in. safe-edge flat smooth file; one each of 4-in. and 6-in. second-cut and smooth half-round files; a $\frac{1}{8}$-in. square tapered file, 5 in. long; a $\frac{1}{4}$-in. square tapered file 6 in. long; three small round files, $\frac{1}{8}$ in., $\frac{1}{4}$ in., and $\frac{5}{16}$ in. in diameter, and 4 in., 5 in., and 6 in. long respectively; a small or triangular file; one 5-in. knife edge bastard; one 5-in. knife edge smooth; and one each 5-in. bastard and smooth warding files. For extra fine work, a set of needle files, as used by watchmakers, is very useful; get the large set, at about 3s. per doz., which includes round, square flat, knife, half-round, fish-back, crossway, triangular, flat rasp, and half-round rasp.

With regard to the larger class of work encountered on the repair or construction of motor-boat or motor-cycle work, most of the above files will be useful on some parts of the work; but, in addition, a few larger and longer flats, round and square files are needed, such as 12 in. in the flat roughs and second cuts, and 10 in. in the half-round roughs, second cuts, and smooths, while the square and round files will be proportionately long and larger in diameter, namely, $\frac{3}{8}$ in., $\frac{1}{2}$ in., and $\frac{5}{8}$ in., by 10 in. or 12 in. long.

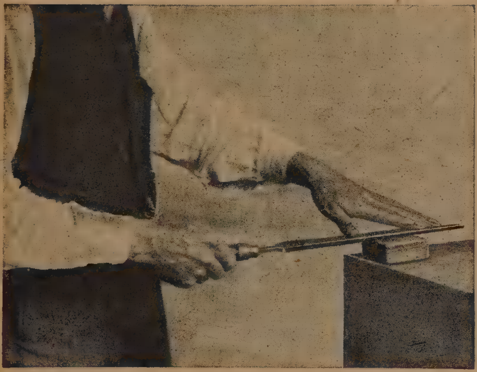


Fig. 2.—Height and Position for Filing on a Broad Surface

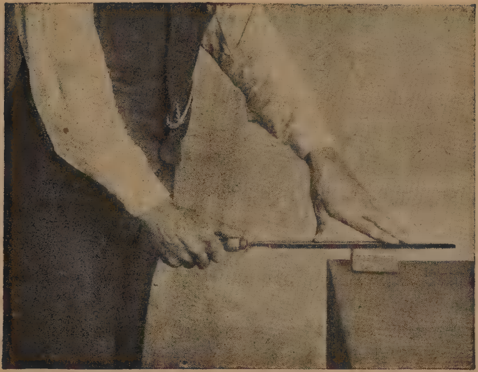


Fig. 2A.—Work in a Position Too Low for Easy Filing

The Files in Use.—New files should invariably be used for the first time on brass or gunmetal, and kept for that purpose alone as long as possible; afterwards they should be used up on steel and wrought iron. A file that has been used on steel for some time will not cut brass properly. Sometimes, in the case of a new file, one side is kept for steel and the other for brass. When removing the scale from castings or forgings, it is economical to use the most worn files first, then, after the hard skin has been removed, the newer files may be brought into use. Always use a handle on the file (firmly driven on) as it is conducive to better work and greater comfort; bradawl handles are recommended for the small files.

Holding the File.—The handle should invariably be held so that the right thumb is on the top, this being the natural and best position for the muscles of the wrist to give simultaneously the push and downward thrust. The point of the file is steadied by the left hand, either by pressing with the palm of the hand, or the four fingers only; when filing on narrow pieces of metal, the operator often grips the file near the point with the fingers and thumb (see Fig. 3).

Cleaning Files.—The machinist cleans his files with a file brush of short steel wire, with a chisel-shaped piece of soft wood, or with a $\frac{3}{16}$-in. piece of round iron or brass wire flattened at the point like a chisel, this last method serving to remove obstinate clogs of metal from between the teeth. Steel, wrought iron, copper, tin, and solder cling to the file more than do other metals, but if chalk is rubbed into the teeth of second-cut and smooth files, clogging will be minimised, especially so when "draw-filing."

Safe-edge Files.—The advantage of a safe-edge on a file is shown in Fig. 4, which shows a case where it is desired to file close up to a shoulder without actually removing metal from the shoulder, A representing the safe-edge against the shoulder. Fig. 5 illustrates a case in which the shoulder only has to be filed, and the safe-edge A is downward. Fig. 6 shows the effect of undercutting at B when a safe-edge is not used. Two further examples are shown in Figs. 7 and 8. In Fig. 7, a winch handle is being filed out, and the square file having one safe-edge at C can be used to guard any side in succession by simply turning the file over. Fig. 8 shows the triangular file (miscalled "three-square") with the teeth ground out from one flat or side; this safe-edge can be turned to either D or E.

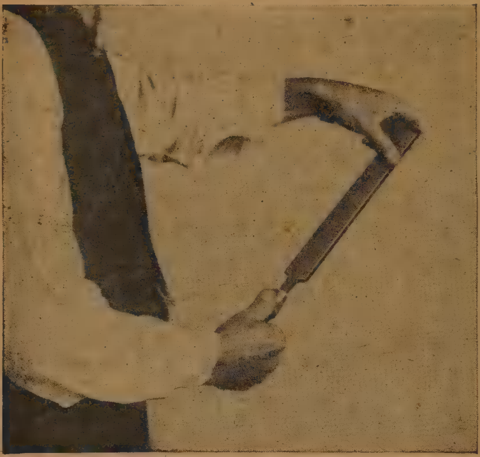


Fig. 3.—Holding the File for Working on a Narrow Surface

Using Point of the File.—A surface that is being cross-filed is always made more or less rounded, according to the skill of the operator; the rounded portion is shown exaggerated at F (Fig. 9), and it needs to be worked down evenly and flat to the "straightedge" by pressing hard on the point of the file and giving very short strokes so as to limit the area of cutting to the high place. The same thing happens when filing out a square or other shaped hole (as in the section, Fig. 10), and here the file handle must be grasped firmly by both hands (see Fig. 11) and in such a way that only the point end does the cutting, limiting the stroke as before to the high parts of the work.

Draw-filing.—Draw-filing is a method of giving a finished appearance to narrow flat surfaces and edges of machine parts that are being prepared for emery-cloth polishing. Only second cuts and smooth files are used for this work. The operator stands end on to the work, grasps the file at its two ends (at H and J, Fig. 12), and then pushes the file and draws it to him a great number of times after the manner of using a spoke-shave on wood-work (see Fig. 13). The file must not be allowed to wobble, and the scratches or cutting marks will indicate whether the work is being done satisfactorily. Draw-filing requires a little more practice than cross-filing. Curved parts and radii are treated in a similar manner with half-round files, the motion on the curved part (see the arrows in Fig. 14) being obtained by constant and dexterous twisting of the file by the wrists.

SCRAPING METALS

It was not until the year 1840 that the superiority of plane metallic surfaces finished by the aid of scrapers was first demonstrated by Sir Joseph Whitworth at the meeting of the British Association at Glasgow. At that meeting surface plates were exhibited possessing a high degree of accuracy which was exemplified by various experiments performed with

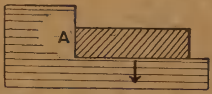


Fig. 4.—Section Showing Safe-edge of File against Shoulder

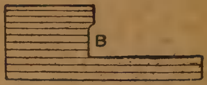


Fig. 6.—Section Showing Undercutting: Safe-edge not Used

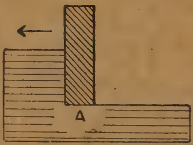


Fig. 5.—Section Showing Safe-edge of File Downwards

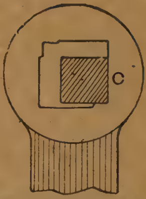


Fig. 7.—Use of Safe-edge in Filing Hole in Winch Handle

them; the surface of these plates was produced by filing and scraping only without being ground by emery-powder and water, which was the general practice at that period. Since that time the surfaces on lathe beds, slide-rests, the flat surfaces on stop valves, the butterfly valves, etc., of steam and gas engines, and the sliding surfaces of machine tools generally have been produced by filing and scraping to the corrections taken from a standard surface plate.

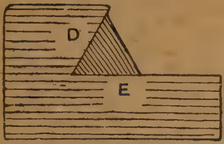


Fig. 8.—Triangular File with Safe-edge

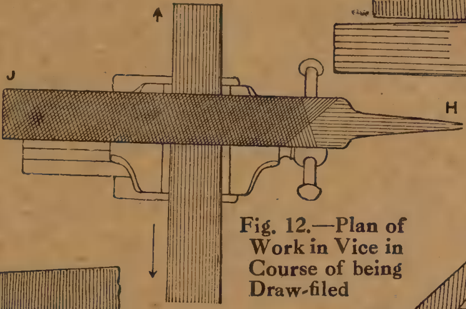


Fig. 12.—Plan of Work in Vice in Course of being Draw-filed

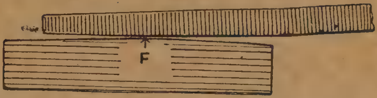


Fig. 9.—Rounded Surface Produced by Cross-filing

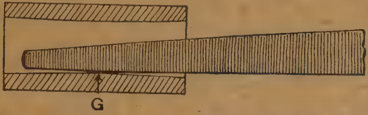


Fig. 10.—Rounded Surface Produced in Filing-out Hole

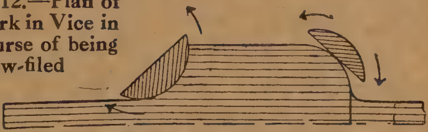


Fig. 14.—Filing Curved Work

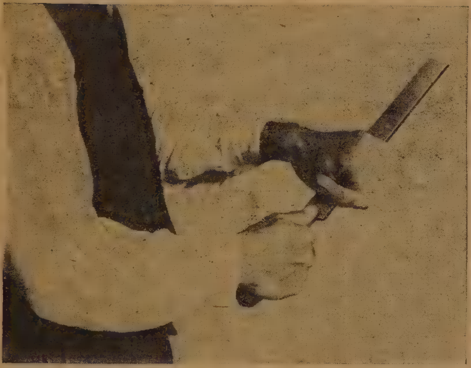


Fig. 11.—Holding File when Point is to be Used

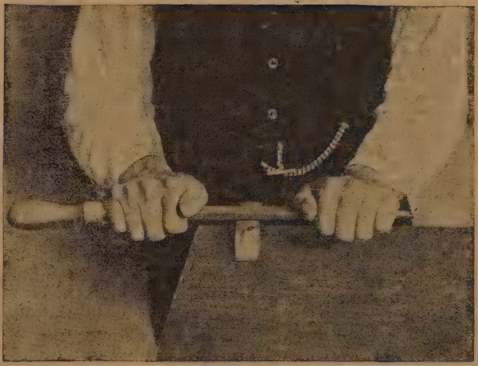


Fig. 13.—Method of Draw-filing

The conditions that should be fulfilled in practice for metallic surfaces for mechanical purposes are that the bearing points should be in the same plane, they should be at reasonably equal distances from each other, and they should be sufficiently numerous for the particular application intended. On surfaces that are fixed or bolted together, the bearing points or patches in actual contact may without disadvantage be less in number and further apart, but in the case of sliding surfaces the points or frictional patches should be numerous and close together. By the process of grinding these conditions cannot be obtained, as the action of the emery-powder cannot possibly be applied only at the parts which are in error; in practice it collects in greater quantity about the edges of the metal than upon the interior parts, producing work of the bell-mouthed form. In producing a true plane surface the operator must have the power of acting on the parts of the surface in error independently of the remainder; and this is done by means of filing and scraping. The reader may have noticed the even regularity of the bearing points or bright frictional patches on a new slide-rest and lathe bed. In the absence of a surface plate the lathe bed or slide-rest affords a fair substitute upon which to test small work when truing up with file and scraper. Red ochre and oil mixed to a paste is rubbed very thinly and evenly on the plate or lathe bed, and the work in hand, being previously filed up and tried with a straightedge, is then rubbed on the thinly spread ochre. Some of the ochre sticks to the work, indicating the high parts which must be reduced with files. Second-cut files are used at first, and then smoothes, and finally scrapers. The red ochre must be lessened as the work progresses, till finally there is scarcely any left on the surface plate.

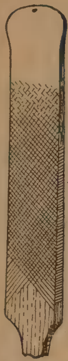


Fig. 19.—Rounded-nose Flat Scraper

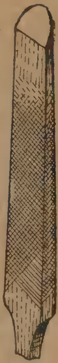


Fig. 20.—Gouge or Round-nose Scraper

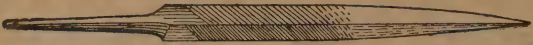


Fig. 15.—Triangular Scraper

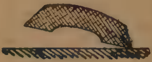


Fig. 21.—Forging Half-round Scraper

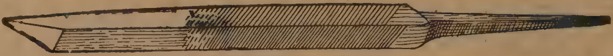


Fig. 16.—Triangular Scraper

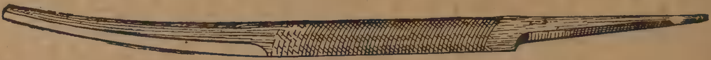


Fig. 17.—Half-round Scraper

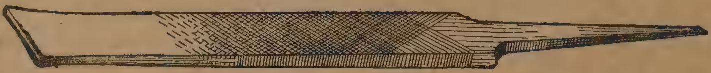
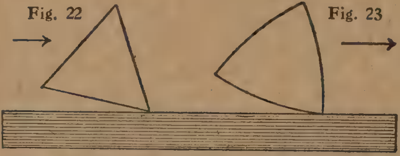
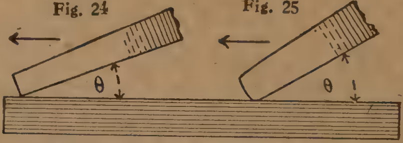


Fig. 18.—Flat Scraper



Figs. 22 and 23.—Triangular Scraper, Correctly and Incorrectly Ground



Figs. 24 and 25.—Flat Scraper, Correctly and Incorrectly Ground

The scrapers for metal do not figure largely in the home workshop, due, doubtless, to a lack of knowledge as to how they should be used.

The Scrapers Described.—Scrapers are commonly made from old worn-out files, the shape of these being already suited for the purpose without much additional labour. Not a large variety is required in the home outfit—the most useful being the triangular (Figs. 15 and 16); the half-round (Fig. 17), made from a half-round smooth file; the flat scraper, made from a 6-in. or 8-in. flat file (Fig. 18) and used for producing flat surfaces; the rounded-nose scraper (Fig. 19), made from the flat file, and used on the curved surfaces of small bearing brasses of 1½ in. diameter and upwards; and the gouge or round-nose (Fig. 20), made from a small half-round file, is suited for easing out small bushes, etc.

Making the Scrapers.—As just mentioned, scrapers are usually made from old files, but occasionally flat, round, and square-section tool steel is used. In making them from files, the teeth near the cutting portion of the intended scraper should be ground entirely out on a wet grindstone, when no subsequent forging is intended as on the triangular and flat scrapers; when, however, the shape necessitates forging, the files may as well be annealed at first by getting them to a bright red heat (but never white or the steel will be ruined) and then plunging into dry, air-slaked lime till quite cool; the teeth can then more readily be ground out, saving much time and labour. The triangular scrapers need no forging, but the half-round, when forging is in progress, should be hammered on the edges to form a hollow space as in the cross section shown by Fig. 21. This shape leaves less surface to grind and rub on the oilstone, and the cutting edges can more readily be kept flat and sharp. Flat scrapers that are made from files more than 8 in. long are forged thinner at the cutting edge.

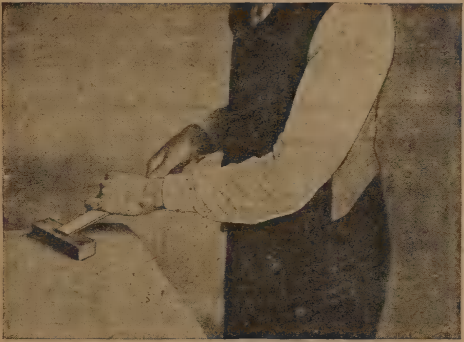


Fig. 26.—Rubbing Flat Face of Scraper

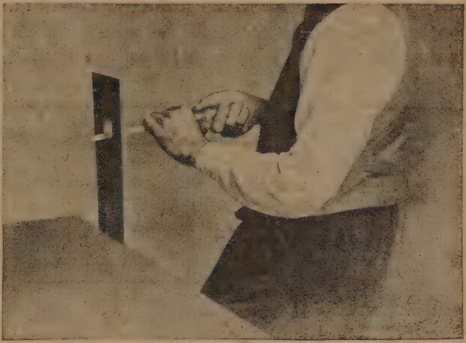


Fig. 28.—Easing Hole with Scraper

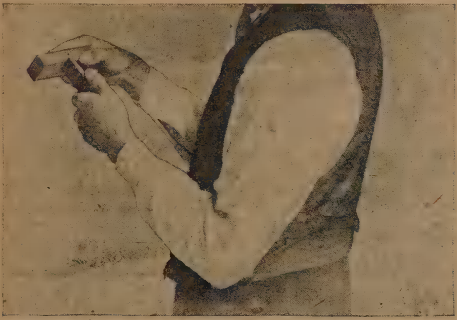


Fig. 27.—Rubbing Square Edge of Scraper

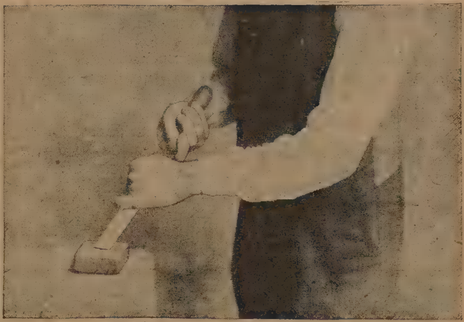


Fig. 29.—Holding the Flat Scraper

For use, scrapers are made "dead hard," the temper not being let down as in other edge tools. The method is to heat to a bright red, and plunge at once into clean cold water, moving constantly till cool.

Grinding and Oilstoning.—The cutting edges must now be again touched up on the grindstone, and finished on the oilstone, and considerable pressure must be exerted on the scraper to get a satisfactory cutting edge. A great failing with the novice is in leaving off oilstoning before a cutting edge is obtained, and in both grinding and oilstoning care must be taken to keep the faces as flat as possible. Fig. 22 shows the cross section of a triangular scraper correctly ground and oilstoned, and at the proper angle for cutting. Fig. 23 shows the same with rounding edges due to careless grinding and oilstoning; the same effects are shown on the flat scraper (Fig. 24) correctly ground, and at a good angle with the work for cutting with a push stroke. Note in Fig. 25 the dull edges due to roundness caused sometimes by bad grinding or an untrue grindstone, and in time after much use by repeated oilstoning; the angle of cutting is also more obtuse and requires greater effort in use. The arrowheads indicate the direction of cut in each case.

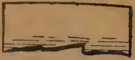


Fig. 30.—Slight Curvature on Edge of Flat Scraper

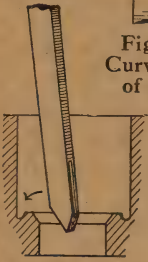


Fig. 32

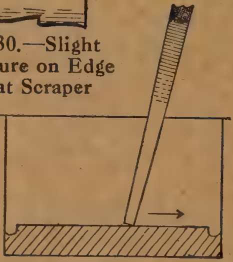


Fig. 31

Figs. 31 and 32.—Instances where Flat Scraper is Used with a Draw Stroke

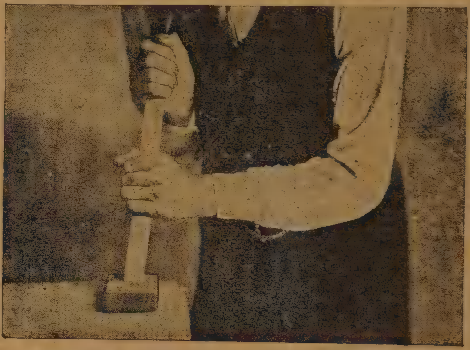


Fig. 34.—Using Long-handled Scraper

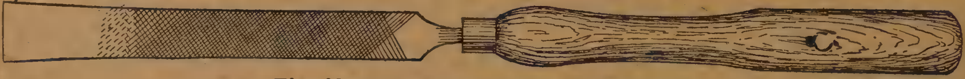


Fig. 33.—Flat Scraper with Long Handle

Of the photographs, Fig. 26 shows the flat scraper being rubbed on the stone on its flat faces, and Fig. 27 shows the end or square edge being oilstoned. No little skill and care is required to keep the oilstone level on so narrow an edge. A circular or scouring motion imparted to the stone is the surest and quickest method to obtain and maintain a sharp flat edge. A really good edge should pare the flat part of the thumb nail with apparently little effort.

Holding the Scrapers.—Scrapers are used by the jeweller, engraver, model-maker, general-machinist and engineer. The triangular scraper shown by Fig. 15 (p. 114) is used on both flat and curved surfaces, and notably in easing out round holes, such as the gunmetal bushes in the connecting-rods of small engines, etc. Is usually a hack tool, and is used for cleaning off rust, paint, dirt, grease and also the sand and scale on small bronze castings before the files are used; occasionally scraping, and a final finish with emery-cloth, is resorted to on brass-work. The scraper shown by Fig. 16 (p. 114) is ground off like a graver, and is a useful shape for getting into corners and angles, such as the V-grooves of slide-rests, etc., or intricate engine and motor parts. The half-round (Fig. 17) and the "flat" with rounded nose (Fig. 19) are used for bedding-in the brasses of shafting. The half-round is used circumferentially and the round-nose longitudinally, one counteracting the other, and preventing chatter marks in the work; these tools in small sizes are very useful in motor work also.

In the flat scraper (Fig. 18) the cutting edges are square, and are never ground chisel-shaped; a very slight curvature is given to the front edge when grinding, as shown in Fig. 30. This scraper is always used for getting up to a standard surface plate such flat surfaces as the flat valves in gas and steam engines, and the slides in lathes and machine tools generally. The amateur builder of lathes and large models will find this a useful type. Another particularly useful tool is the round-nose (Fig. 20), and when used in bushes in conjunction with the triangular shape it counteracts the tendency to chatter marking which is inevitable if scraping is continued in one direction only. To obviate chatter marking, the cutting strokes should be varied in direction or crossed, but not quite at right angles, an acute angle being preferable.

Scrapers for any work other than jewellery are grasped firmly in both hands. Fig. 28 shows the method of holding the triangular and half-round scrapers when easing out a hole or bush or when using them generally. The flat scraper is nearly always used with a push stroke, and is held as shown in Fig. 29. It is inclined at an angle of about 20° to 25° with the work; and occasionally this scraper is used with a draw stroke, as when the face to be operated upon is in a recess as shown by Fig. 31. A modification of the draw stroke is also necessary in scraping a valve seat that is badly "scored," such as sometimes occurs in steam and gas engine plant (see Fig. 32). In a very small space difficulty is experienced in getting sufficient angle for cutting, but this may be effected by backing off the edges of the scraper like a drill, but rather less in clearance angle. In the draw stroke a long handle is used on the tool, as shown in Fig. 33. This handle rests against the operator's shoulder, and the scraper is drawn towards him (see Fig. 34). The strokes, whether draw or push, are always short, never much more than ½ in., and they get shorter as the work nears the finishing stages.

Indiarubber and Glue Varnishes

Indiarubber Varnish.—Digest in a wide-mouthed bottle 2 oz. of indiarubber in fine shreds, with 1 pint of spirits of turpentine. Let it stand two days undisturbed, and then stir the mass with a wooden spatula. Add another pint of turpentine, and shake occasionally until all the rubber is dissolved. Mix 1½ lb. of this solution with 2 lb. of pale copal varnish and 1½ lb. of boiled linseed oil; shake the mixture, and place it on a sand bath until the mass has become perfectly mixed. This will give a very good rubber varnish, the copal varnish making it more durable. It serves also as a very strong cement for general use, but for that purpose should be thicker.

Glue Varnish.—Dissolve 1 lb. of glue in 2 gal. of water. When ready to use it, add 1 oz. of potassium bichromate to the glue solution. Apply at once, as upon standing in the light the mass will gelatinise and become unworkable. The addition of a little thymol or borax will serve as a preservative. The quality of the glue determines that of the varnish. Thus dark glue will make dark varnish, and white glue a very pale varnish, while gelatine makes the whitest varnish. This glue varnish forms the basis of some leather varnishes. Lithographers also use something of the kind. It has the great advantage, compared with ordinary glue, size, etc., of being waterproof.

Easy Bookbinding

THIS chapter will describe in a simple way how a book may be strongly and neatly bound. Bookbinding, on the lines here laid down, is very suitable work for women and young people, a fact which the reader will glean for himself from some of the photographic illustrations to this chapter. It is quite possible to bind books really well without the aid of machines, but certain tools and implements are necessary.

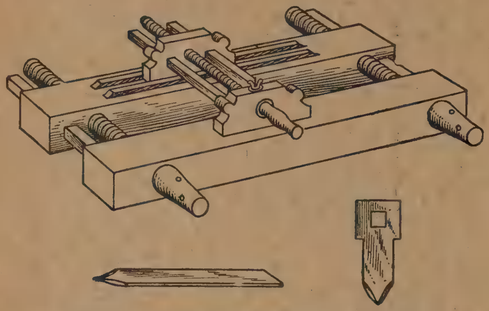
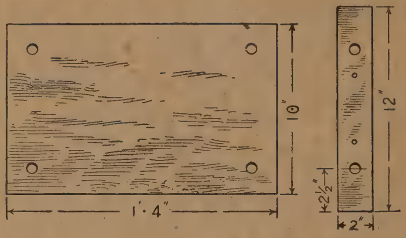


Fig. 1.—Laying Press with Cutting Attachment

Laying Press.—The most important implement is one known variously as the lying press, laying press, backing press, or cutting press. It squeezes the book together for backing, and for cutting the edges. The cheapest of the specially-made presses (see Fig. 1) costs a few pounds by the time it is properly set up and in working order, but a cheap substitute can be made to answer very well (see Fig. 4). Its construction is obvious. Obtain a set of four carriage bolts about 10 in. long, complete with nuts. Four strong iron clamps or bands must be obtained to suit these, each clamp being 12 in. long and 2 in. wide, and having two holes for the carriage bolts to pass through. The holes in the two lower iron bands must be square, so as firmly to hold the square part of the bolts ; the holes in the two upper bands should be round and of ample size. The holes should be placed about 2½ in. from the ends of the bands, and all must exactly correspond with one another. Since it is necessary to screw the bands to the boards two smaller holes a little nearer the centre must also be made in each of the bands, these smaller holes being countersunk for screw heads. The boards for the press must be at least 2 in. thick, and should measure 16 in. by 10 in. ; they need to be planed and glasspapered very smooth. The iron bands should be screwed fairly



Figs. 2 and 3.—Board and Clamp for Home-made Press close to the ends of the boards, after having bored holes in the latter for the passage of the carriage bolts. The setting out of iron bands and boards is shown in Figs. 2 and 3. The nuts are turned on the bolts by means of a wrench, an open-ended one being the most convenient. It saves tedious screwing to have a number of iron washers to place between the nuts and the press when a small book is being pressed. A copying press or linen press could be used for pressing books, if nothing else were available.

Fig. 4.—Home-made Laying Press

Sewing Frame.—This is the next appliance to be considered. The photograph (Fig. 5) shows a tradeworker's sewing frame ; the book is resting on a flat board, slightly raised from the table upon which it stands by four small feet. At each end of this board, close to one side, there is an upright wooden screw. A horizontal bar is supported on the screws by means of two nuts which allow of the height of the bar being altered to suit requirements. The tapes that form the bands of the book are attached to this bar and stretched downward to the board, below which each is kept taut by means of a little key.

It is not difficult to improvise a sewing frame ; all that is wanted is something that will hold tape bands tightly in a vertical position at convenient intervals. A small embroidery frame clamped upon a table in an upright position answers very well. A board or low box can generally be found that does for a platform to raise the sections of the book to the desired height upon the tapes. The back of a kitchen chair has been made to serve as a sewing frame, and even a towel-airer has been used for the purpose. A little ingenuity will enable most people to improvise something suitable.

Small Tools, etc.—There is a number of small tools necessary, but they are commonplace, with the exception of the hammer and the various pressing and backing boards. The list is as follows : A pair of strong scissors, a strong knife, glue-pot, glue and paste brushes, a folder, a backing hammer, a steel foot-rule, a small tenon saw, a pair of 12-in. backing boards, pressing boards, pressing tins, a pair of dividers, and a carpenter's square.

The backing (or beating) hammer is shown in Fig. 6, but a shoemaker's hammer (see Fig. 7) may be made to serve the purpose, and is only about a quarter the price. A folder, or folding-stick, is a perfectly straight paper-knife made of bone. A small tenon-saw costs a few shillings, and any small straight saw may be used provided the teeth are fine with not much " set " or spread. A jam-pot resting on two or three nails in a saucepan makes an excellent glue-pot.

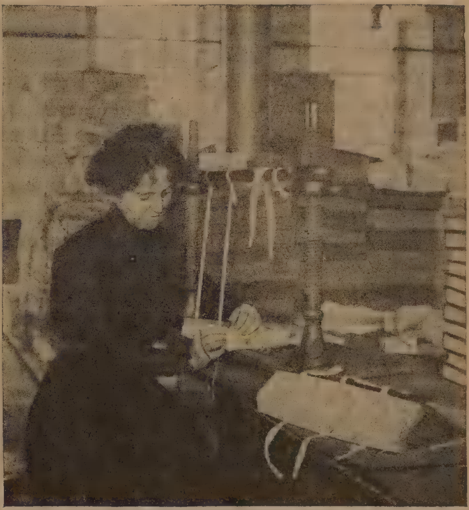


Fig. 5.—Trade-worker's Sewing Frame in Use

Pressing boards are merely rectangular pieces of hardwood quite free from knots and smoothly planed. They are made in various sizes, among which 10 in. by 6 in. and 13 in. by 9 in. will be found to be very convenient.

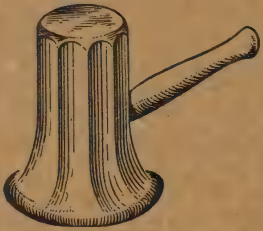


Fig. 6.—Backing Hammer

A pair of backing boards must be obtained. They must be of very hard, smooth wood, and of the section indicated in Fig. 8.

The pressing tins are rectangles of tin-plate cut in various sizes, a pair measuring 13 in. by 9 in. being useful to begin with.

Materials.—Materials for binding must also be bought, but at first small quantities should be obtained. Nine inches (¼ yd.) of bookbinder's cloth or canvas will cover a couple of small books, and a few sheets of good white printing-paper will do for end papers. Strong linen thread will be needed for sewing, and some needles to suit the thread; a few yards of narrow linen tape, a small quantity of the best glue, some strong brown paper, paste and plenty of waste paper will also be required.

Re-binding a Paper-covered Book.—A good start may be made with a cheap paper-covered book that is considered worthy of a more permanent form of binding. It has already been folded, and the edges are probably sufficiently smooth to do without cutting; therefore these two troublesome processes can be omitted, and they will be more easily learned later, when some of the work has become familiar to the worker. The first operation is to take the book to pieces very gently. Remove the paper cover and any pages of advertisements that may be found at either end. Rub a wet sponge down the back to soften any paste that may stiffen it. Cut all the threads of the sewing, and pull the sections carefully asunder. Any loose threads should be removed from the sections. If any of the sections have been disturbed, see that the pages follow one another in proper sequence. The end papers must next be cut. For a beginner, some plain white printing-paper of good quality answers very well, but it ought to be strong, because it does important work. Fold the paper and cut from it four double pieces resembling sheets of note paper. These should be exactly the size of the page of the book. Slip the first double piece into the second, and the third into the fourth, so that there are two pairs. These make the first and last sections of the book. All the sections and these end papers should be carefully straightened, laid between two pressing boards and placed in the centre of the press. Screw the press up tightly and evenly and leave it for a day at least.

Glue.—While the book is in the press, both glue and paste should be prepared, as they will shortly be wanted. Scotch glue is considered the best glue for the bookbinder's purpose. See that the glue-pot is perfectly clean with no old remains of glue in it. Break a small quantity of glue into little pieces, place it in the inner

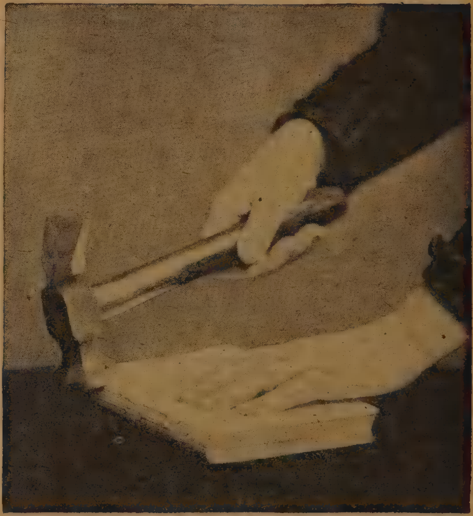


Fig. 7.—Shoemaker's Hammer in Use as Backing Hammer

pot, cover it with cold water, and leave it to soak till the following day, when it will have swollen considerably. Put some water in the outer vessel, and set the inner one in place. Set the pot on the side of a stove or over a low gas flame, and let the softened glue melt slowly, giving it an occasional stir. Glue will melt over again several times, but it will not retain its strength for an unlimited number of meltings; therefore, it is better to make only a small quantity and to renew it frequently. The pot should be thoroughly cleaned out between times. Amateurs, as a rule, make glue too thick. It should be used hot, and it should run quite easily from the brush.

Paste.—Bookbinders use two kinds of paste. One is made very thick indeed, while the other is quite thin. It is the thin sort that will be required for this book. Place a good tablespoonful of wheaten flour in a basin and stir in sufficient water to make it the consistency of thick cream. Continue to stir until not a single lump remains. Pour boiling water on this mixture, stirring all the while till it looks quite clear and transparent. Some people use the paste without any more preparation, but it is much better to boil it in a saucepan for five minutes, stirring it constantly to keep it from burning. As a preservative, add powdered alum (a teaspoonful to a pint of paste), or a few drops of an essential oil, such as that of cloves. When the paste becomes either watery or sour it should be thrown away. It is most important that paste should be perfectly free from lumps.

For thick paste a very much larger proportion of flour is necessary. Mix flour and water into a thin batter. Stir it constantly over the fire in one direction, using a thin pot stick. Continue stirring until it becomes so thick that it is difficult to stir, taking great care that it does not burn. Preservative should be added as before.

Knocking up.—There are a few technical terms which a beginner should learn in order that he may clearly understand certain directions. The four edges of a book have distinctive names: the top is the "head"; the front edge, the "fore-edge"; the bottom, the "tail"; and the fourth edge, the "back."

The term "knocking up" has also a particular signification. Take the book from the press without removing the pressing boards. Hold it with the open hand placed flat upon each board, and bring the back (boards and sections together) down rather sharply, but lightly, upon the top board of the press. This is to make all the sections level. Knock the head in the same way. This process should be repeated several times with the head and back, and the other edges will obviously be right if these two are straight and level. This is "knocking up."

Marking up.—The book is now to be "marked up" for sewing. All average-sized books should have five sewings; a small one does with four, and a large one should have six. The two end sewings are always done in what is called "kettle-stitch," and the centre sewings are done over the tape bands.

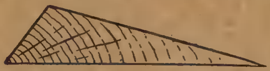


Fig. 8.—End View of Backing Board

Get the press into a proper position, with the boards standing upright and the nuts on the bolts to the worker's right hand. The boards of the press should be sufficiently far apart to allow the book and pressing boards to pass between them quite easily.

Knock up the book as explained above, and when the sections are perfectly square, push back the pressing board on each side, so as to leave the back of the book about $\frac{1}{8}$ in. beyond them. Hold all firmly, back uppermost, with the left hand, and lower it into the press.

With the wrench in your right hand, screw up the two bolts at one end till they grip the book sufficiently; then proceed to screw up the other bolts. All the bolts should be tightly and evenly screwed up, and the back of the book should project slightly. The book must be perfectly square. It is about to be marked for sewing, and if it is not quite straight all the sewings will slope and the book will be permanently crooked. To ascertain that it is straight, lay the carpenter's square against it; if it is the least little bit crooked, the knocking up and placing it in the press must be done all over again. It is sometimes a great help to a beginner to get a second pair of hands to attend to the screwing up, leaving the binder's attention to be given undividedly to the sections and boards.

Sawing.—When all is in order, draw a pencil line across the back of the sections 1 in. from the tail, and another one ½ in. from the head. The carpenter's square should be used to get these lines at right angles to the sides of the book. Take a tenon-saw and make a cut (a "kerf") upon each of these lines. These two cuts are intended to make tiny holes in all the sections where the kettle stitches are to be made. They should be sufficiently deep to cut the middle sheet of each section, but no deeper, or they will make a series of ugly holes (see Fig. 9). Next, the centre of the back between the two saw marks must be found with the dividers. Two pencil lines must be drawn there just the width of the tape apart from one another. Make two more double rulings half-way between the centre marks and the saw marks. All these marks must be perfectly square with the sides. The book is now ready for sewing and may be removed from the press.

Sewing.—Place the sewing frame upon a table, with the screws and horizontal bar to the front and the board to the back. There are differences of opinion as to how the sewer should be seated at the frame. In the photograph of the trade worker (Fig. 5) she is shown seated at the left-hand end, with her work close to the left upright screw. Her left arm is passed behind the screw. Other workers push the tapes towards the right-hand end of the frame, preferring to pass the left arm between the screw and the tapes. The main thing is to adopt the position that gives the most freedom with both hands. Suspend three lengths of tape from the horizontal bar, and take a few sections of the book, and lay them with their backs against the tapes. Arrange the latter so that they will lie exactly between the three double rulings made for them, and tighten them in that position. If is often advisable to raise the sections for the convenience of sewing them. A pressing board can be placed under them to make a little platform.

Run over the sections very carefully to see that they follow one another in proper sequence, and to see to any that have been displaced. See that there is a pair of end papers both at the beginning and the end. Lay the sections face downwards, and, as the book is sewn backwards, the last end paper is taken up first. Open the section at the centre, place the left hand in it, and lay it with its back to the tapes, bringing the marks to their proper place against them. The tail should be on the right hand. Thread a needle with a long piece of linen thread; pass the needle from front to back through the saw cut at the tail; catch it with the left hand, and bring it out to the front again at the pencil mark to the right of the first tape. Leave an end of thread at the saw cut. Re-enter the needle at the left pencil mark of the first tape, and bring it out again to the right of the centre tape, and in again at the left of it; bring it out to the right of the third tape, and in at the left of it; and lastly, bring it out through the saw cut at the head.

Take the next section; open it at the centre as before and lay it in its place against the tapes. Insert the needle this time at the head saw cut, and sew across the tapes from left to right, ending by bringing the needle out through the tail saw cut. Tie the thread to the end that was left in the first section. In all these sewings the needle must go in and out exactly upon the pencil marks at either side of the tape bands. Lay on a third section as before, and sew it along in the same way as the first. Next make a kettle (or catch) stitch to secure this section to the preceding one (see Fig. 10). Pass the needle between the first and second sections to the right of the head saw cut, and bring it out at the head. Before drawing out the needle, pass the thread towards you under the point, draw out the needle, and pull it tight (see Fig. 10). Lay on a fourth section, and sew it from head to tail as before; make a kettle stitch at the tail, inserting the needle to the left of the saw cut and between the second and third sections. Proceed in this way with all the sections.

When the book is sewn it should have one long continuous thread going alternately from tail to head and from head to tail throughout the sections. At the last sewing a double kettle stitch should be made, to fasten off.

It is obvious that the whole sewing cannot be accomplished without a joining in the thread; a new length must be knotted on as each becomes exhausted. The weaver's knot is the one generally used for the purpose (see Fig. 11). Make a slip knot in the end of the new thread and put the loop over the end of the old one, pull the new thread as if to take out the slip knot, and it will catch in the old end and make a tight and secure knot. The knot is made at the spot where it can be drawn into the centre of a section, and it should never be left on the outside to make a mark on the binding.

It is most important when sewing to make quite sure that every section is opened in the centre, otherwise some sheets will escape being sewn, and be left quite loose. The sewing should be firm, but the thread must not be drawn too tight, or it may break when the book is being backed later on, and such an accident would necessitate entire re-sewing. On the other hand, loose sewing makes a book very difficult to bind. Remember that paper is very easily cut by a thread drawn out roughly, or in a contrary direction. One careless movement may suffice to cut a section all the way between two bands. The thread should not be too coarse, or it will thicken the back unduly. Whity-brown (that is, unbleached) thread is much stronger than white, because it has not been weakened by bleaching. The strength of the entire binding depends so much upon the sewing that a poor quality of thread should never be used. For sewing valuable books, ligature silk, undyed, such as that used by surgeons, is frequently employed, it being stronger than linen thread.

When the sewing is finished, the tapes may be cut, leaving ends (known as "slips") of about 2 in. at each side beyond the sewing. The book must be carefully handled now, because the tapes might be inadvertently pulled out, and that would entail re-sewing the whole book.

Knock up the sections with a pressing board at each side, and place them in the press to get a good squeeze for some hours; the back is sure to be somewhat thick after the sewing, and this will reduce it. The tape bands will need to be pulled to readjust them to the size of the back after pressing.

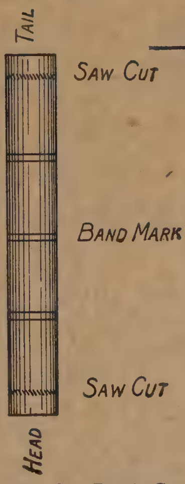


Fig. 9.—Book Saw-cut for Sewing

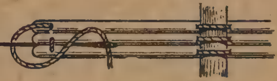


Fig. 10.—Kettle Stitch or Catch Stitch

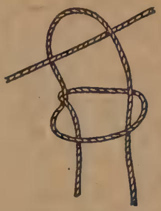
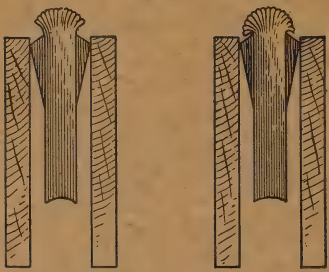


Fig. 11.—Weaver's Knot for Joining Threads

When two or three books of the same size have to be sewn, one can be sewn upon the top of another upon the same tapes, provided the latter are sufficiently long to allow for all the slips. When the top book of the pile is finished, slide it up on the tapes to within a couple of inches of the top of the bands, and cut the tapes so as to leave 2-in. slips. Repeat this with each of the books.

Pasting in End Sections.—Most bookbinders paste the end sections to the adjoining ones. Lay the book on any flat surface, and turn the uppermost section; take a piece of waste paper, and lay it carefully along the next section about ⅛ in. from the back; dip the middle finger into paste, and rub along the exposed portion. The waste paper is placed there to keep the paste within proper bounds. Remove the waste paper and replace the turned-back section. Rub it down along the back edge. Turn over the book on the other side, and repeat the process. Leave it under pressure to dry.

Before proceeding further, carefully examine the sewing to see that the centre leaf in each section has been caught in, otherwise you may find loose sheets ready to drop out when the binding is finished.



Figs. 12 and 13.—Use of Backing Boards

Gluing up.—The next two processes should be done without any long interval of time between them; therefore, the binder should not begin the first without being sure of being able to finish the second perhaps an hour later. Have at hand some hot, thin glue. Get together some old book boards or oblong pieces of waste strawboard, cut, for example, from the side of a box, and have plenty of waste paper handy.

Bring down the slips very carefully along the sides of the end papers so that they may be caught in, and place a piece of strawboard at each side of the book. The slips and sides must be protected against stray drops of glue. Knock up the book very carefully, for if the back is glued before getting it perfectly square it will be extremely difficult to rectify the fault. Lower the book into the press, leaving the back with the strawboards and pressing boards all projecting about 1 in.; screw the press up firmly, but not too tight. Lay the carpenter's square against it to make sure that all is straight.

Take the glue-pot from the stove if ready; and if the glue is thick, stir in boiling water to thin it. When the glue is in proper order, stand up the brush in the pot, place the handle between the palms of the hands, and rub the hands together, so that the brush revolves quickly in the glue, which will soon froth up till the pot appears to be full. It is now in the proper state to use. Brush over the whole back with it, getting it well into every section, care being taken that the book is screwed up so tightly as not to permit the glue running between the sections. Should, however, it be too tightly screwed up, the glue will only lie on the surface without getting into them at all. The glue should be very thinly spread; therefore, as beginners are liable to err on the side of liberality, it is as well to have at hand a clean brush with which to remove superfluous glue; the brush is easily cleaned in hot water. A bookbinder must learn to be neat-handed with glue, as otherwise accidental drops may do considerable damage.

Leave the book as it is for an hour or so until the glue has set, but not long enough for it to become quite hard, because while it is still in a pliable state the rounding of the back must be done.

Rounding the Back.—Lay the book flat upon a strong table with the fore-edge towards the worker. Place the left thumb along the fore-edge and spread the other fingers on the upper side of the book. Draw the upper sections towards you and strike the edge of the back gently with the broad end of the hammer all the way along (see Fig. 7). Turn the book on the other side, and repeat the operation. This must be done many times on both sides till the book has been given an evenly rounded appearance at the back. Examination of a well-bound, fairly modern book will show that the fore-edge is concave, while the back is convex; the rounding with the hammer and the following processes are what have made it so. Observe also that the back of the book projects slightly at each side over a little groove in which each board rests. The thickness of the boards to be used for the case or cover of the book must now be decided. No rule can be given for this, but the worker is sure to have some books about the size of the one being bound, and these will be a guide. The groove already mentioned should be made a little more than the thickness of the board from the edge of the back. In order to make the book even, a careful measurement should be taken, and a pencil line ruled on each side at a proper distance below the back to indicate the exact place where the top of the longest side of each backing board (Fig. 8) should lie. The backing boards must be held there firmly so that they may not slip while the book is being lowered into the press and screwed up. As professionals have sometimes to make more than one attempt to get a book into the press without displacing the boards, a beginner need not be surprised at having to repeat the process several times before succeeding.

When the book is once safely in the press, it should be screwed up very tightly. It should be so placed that the tops of the short sides of the backing boards are on a level with the top of the press (see Fig. 12). The hammer should now be brought down upon the back in a series of side strokes to left and right, so that the sections may be evenly fanned out from the centre, taking care that the sections are not crushed down by direct strokes. The groove is formed by hammering the outside sections down upon the top of the backing board. No rash strokes should be made to beat any section in the wrong direction, as it does not improve matters to beat it back again into its right position. Most binders use the thin end of the hammer-head first and then the face to finish, but a beginner should be very cautious in using the thin end, for if it is too heavily brought down it will cut the sections. Do not be in a hurry with the work, but be content to make gentle strokes, taking plenty of time to get the back into a round, even shape (see Fig. 13).

On opening any well-bound book, it will be observed how smoothly the pages lie together at the back of the sections. Fig. 14, on the other hand, shows an open book in which the back has been carelessly hammered.

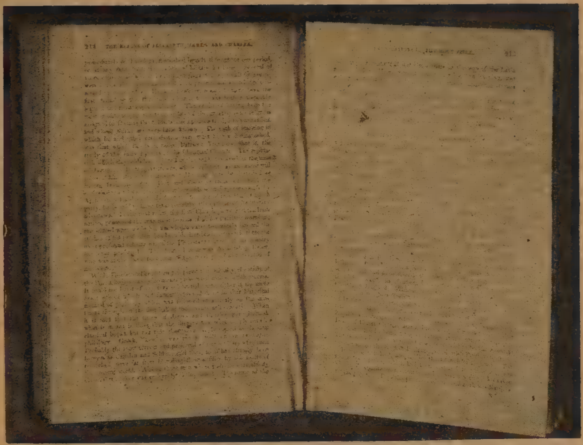


Fig. 14.—Effect of Bad Hammering upon Pages of Book

Boards.—The book is nearly ready for its boards now, and they should be got into order. Strawboard and millboard of various qualities are used for book boards. Strawboard should not be used for a valuable book, because it is very easily broken, but as it is more easily managed than millboard it answers very well for a first attempt. The best sort of millboard is made from old rope, and is so very hard and tough that it is difficult to cut it without proper shears or a cutting press. The cardboard boxes that are sent into the house may provide suitable pieces of strawboard, but, if not, it is bought at a cheap rate. Two thin pieces (one thinner than the other) may be pasted together to make one thick one.

To do this, cover one of the boards with thin paste, lay the other over it, and place both together in the press. Screw them up firmly, but not tightly, and then, after a short time, increase the pressure and leave them quite tight till the following day. The thinner piece of strawboard must go next to the book; were it placed to the outside, the cover would curve outward from the book. If one piece of strawboard is of the right thickness, a piece of tough brown paper must be pasted upon it instead of the thin piece of board, but this can be done after the boards are cut; the brown paper causes the cover to lie in close to the book. The thin board or the brown paper counteracts the pull made by the cloth cover and prevents warping. It is most important that these thin pieces should adhere closely all over without wrinkle or blister.

Fig. 15.—Shoemaker's Knife for Cutting Strawboard

The boards must now be measured and cut. A shoemaker's knife (see Fig. 15) does the cutting well, but slowly. A proper cutter is shown in Fig. 16, A being a wooden or iron table, with a fixed knife screwed on the edge, and B a movable knife hinged in position. This appliance forms a strong shears or scissors.

The covers of all well-bound books project a little beyond the sections at the head, tail and fore-edge, and these small projections are called "squares." Take a pair of dividers and measure from the line that was marked as a guide in backing the book to the fore-edge and allow $\frac{1}{8}$ in. for the "square"; this gives the width of the board. For its height, measure from head to tail of the sections and allow $\frac{1}{4}$ in. for the two "squares." Mark all these measurements upon the board, and rule lines with a sharply-pointed pencil and carpenter's square. When the four sides of the board have been thus marked out, sharpen the shoemaker's knife upon an emery stone or strip of very fine emery paper, or even upon the domestic knife-board, paying special attention to the point. An edge given by emery is better for cutting the strawboard than the finer one produced on an oilstone. The sharpening must be frequently repeated during the process of cutting boards. Grasp the knife as it were a dagger and draw the point of it towards the worker, along one of the fine pencilled lines upon the board. If the knife edge is keen, it will make a clean cut, not very deep. On no account allow the knife to tear the board. Go over the same line again and again till the board is cut completely through. When one good, straight incision has been made, it is not difficult to keep to it in all the succeeding cuts. Should the work of cutting the boards in this way be thought too tedious, any bookbinder will sell a pair of strawboards cut to the right size for a trifling sum.

Headbands.—While the boards are drying in the press the headbands should be attended to. The addition of a headband improves the appearance and lengthens the life of a book. The natural way to take a book from a shelf is to place the forefinger on the head of the book, and to draw it out sufficiently by it to enable the remaining fingers to grasp the sides. When the book is a heavy one, this method puts continual strain upon the head of the back, and unless additional strength has been given to the cloth at that part it is sure to give way sooner or later.

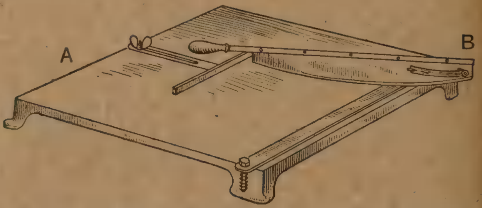


Fig. 16.—Hand Machine Knife for Strawboard

To make a stuck-on headband, cut a long narrow strip of pretty coloured sateen or calico, having very narrow stripes; the stripes should go across the calico, not lengthwise. Drive two tacks about half their depth into a board a foot or more apart. Wind some of the whity-brown thread backwards and forwards over these till there is a sufficiently thick cord. Slip the length of calico underneath this cord with the wrong side uppermost, the cord lying along the centre of the calico. Brush some thin paste along the lower half of the calico, and thoroughly saturate the cord with it. Draw the upper half of the calico over the cord, and press it down upon the lower half. Run the edge of a folding-stick just below the cord to push it well up into its place, and allow to dry.

Although the instructions for preparing boards and headbands have not been given until the book has progressed so far as to be ready for them, it saves delay to have all the pasting finished and dry beforehand. When once the whole process of binding a book is understood, the binder may often take opportunities of preparing things ahead, while the press is doing its slow work upon some part. For this reason, many people like to have several books in various stages of progress, so that there is always something to do at one of them while they are waiting for another. But to work comfortably at several books it is necessary to have a second press.

Before the headband is attached, the back of the book should be cleaned of loose pieces of glue, etc. Wet the back of the book well with thin paste, and leave it to soak for a while to soften the glue. Paste is better for this purpose than water. When it has become sufficiently soft, take a folding-stick and scrape away all the paste and glue gently with its edge, then well rub the back with soft paper to make it quite clean.

The book may now be screwed in the press to steady it; but as on no account must the back be squeezed after the backing is done, see that it projects above the cheeks of the press. Cut two lengths exactly the width of the book from the headband cord; round these pieces with the fingers to make them curve like the back of the book. Brush some thin glue on the back at the head and tail, and affix the headbands so that the double edges of the calico lie on the back in such a position that only the corded portion projects beyond the sections in each. Press the calico carefully with the fingers to make it adhere, and leave the book till the glue is dry.

When all is ready, cut three pieces of stout smooth paper, exactly the size of the back of the book. Give the back an even coat of glue, lay on one piece of paper and smooth it down with the folding-stick. Repeat this with the second and third pieces, and the back should then be perfectly smooth. Any roughnesses that may appear now on the back will show through the cloth binding, so the appearance of the book will depend largely upon the care in cleaning the back and in gluing on the papers without wrinkles. Leave the book in the press till quite dry, and then remove for the purpose of having the boards attached to it.

These preparations have been made with the purpose of giving a close back to the book; for an open or hollow back the process is slightly different.

Attaching Boards.—The slips or tapes should be 1½ in. long, and anything more than that should be cut off. The end papers next the tapes should be left only just wide enough to cover the tapes, say, 1⅝ in.; and at the head and tail of these same end papers about ¼ in. should be cut off. When this trimming has been done at the two ends of the book, lay it flat on its side upon a table, slip a piece of waste paper under the trimmed end-paper and slips on the upper side, and lay the slips neatly in their places. Coat the tapes and paper with hot thin glue, saturating the tapes thoroughly and working the glue well into them, but not so liberally that it will ooze out under subsequent pressure. Lay one of the prepared strawboards down upon the glued end-paper and slips, taking care to place it exactly in its right position, with the thin board or paper next to the book. Press it firmly with the fingers to make it adhere properly, then lay a pressing board behind the book and turn the strawboard back upon it. See that there are no wrinkles in the slips and half end-paper, but that all is smooth and neat, and that there is no glue where it ought not to be.

Take a pressing-tin and lay it on the sections, pushing it well into the groove at the back. Turn the strawboard back in its place on the tin and lay a pressing-board on the top of it, keeping it quite clear of the back of the book. Turn the book over on the other side, and repeat the process with the second board. The book must now be put carefully into the press, and left there till the next day.

Attaching the Cover.—The book is now ready for its cover. First, see that the glue-pot is in good order, and have at hand some well-made thin paste. The beginner finds it difficult to believe that a very thin coat of glue or paste will be effective ; and he must resist the temptation to apply too much of it. It is easy to let little drops of glue fall about unawares, and these drops may do a lot of mischief. For example, a drop of glue which has hardened on a pressing board will make a permanent dent upon the cover of the next book which is squeezed against it in the press. All such drops should be removed before they harden ; a cloth wrung out in hot water easily removes glue. The worker's hands must be kept scrupulously clean and free from stickiness. Touching a bright cloth cover with a gluey hand leaves a permanent mark upon it. Glue brushes, pressing tins and boards and everything connected with the work should always be put away clean. The glue which hardens about a dirty brush may cause a lump to come when least wanted or expected. A brush casting its hairs should be discarded, and any loose hairs which get into soft glue or paste should be carefully picked out, for a hair left under an end-paper or a canvas cover always causes a little ridge.

Gather together everything likely to be required, such as the cloth or canvas, scissors, tins, boards, a folding-stick, plenty of waste strawboard and paper, thin paste and glue, and a good-sized glue brush, with which the work can be got over quickly while the glue is hot.

The canvas is likely to be in a roll, so it must be rolled the reverse way to flatten it. Lay it wrong side up on a table. Measure the size of the book, and rule light pencil lines upon the canvas as a guide. Be careful with these measurements, because the cover should be cut very exact. If it is too small it is useless, and if it is too large it has to be trimmed just at a time when delay is awkward. Allow a margin of ½ in. all round to turn in. See that the glue is in good condition, froth it up as before, and coat the canvas all over as quickly as possible on the wrong side. No spot should be omitted, and the glue should be thinly spread.

Lay the cover on a clean piece of strawboard with the fore-edge next the worker, place the closed book upon it also with its fore-edge next the worker, exactly where it should be. See that it lies quite straight with the ½-in. margin round the fore-edge, head and tail. Catch the far edge of the canvas, draw it over the upper side of the book, and make it stick at the fore-edge. See that the squares (the projecting edges) are in their proper position. Place the volume on its fore-edge and strain the canvas well over the back, making it quite smooth with the hands and a folding-stick. The book should now be laid down upon its side again. Raise the canvas on the upper side, draw well into its place, and turn in on the fore-edge, carefully pressing it with the hands and folding-stick. Turn the book over on the other side, and repeat the process.

The cover has next to be turned in at the head and tail. Set the book up on its fore-edge, spreading it out a trifle. Tuck in the canvas neatly at the back, and then turn it over the boards. It is difficult to avoid smearing the headbands ; some binders protect them by slipping a piece of paper between the back and the headband at each end during the process of turning in the back, removing it immediately afterwards. The canvas must be cut away at the corners of the book in order to make it fold over neatly there.

Some people cut away the corners before turning over the edges on the board, but it is easy to cut away too much or too little, the former leaving the board exposed (a very bad fault), and the latter causing a clumsy fold. The best way for the beginner is to turn in the edges right up to the corner, and then to cut away what stands up from the board, leaving just sufficient to allow the edges to overlap slightly. Raise the canvas at the corner, and tuck one edge very neatly under the other.

Most likely the glue will begin to get cold before all this has been accomplished, as speed can only be gained by practice. However, it can be softened again by very carefully holding the book near a fire for a few minutes.

Run the edge of a folding-stick along the groove at each side of the back, and press in the canvas a little at the head and tail at each end of each headband.

The three end papers which remain must now be pasted into their places. Lay the book on its side and place a board behind it to rest the cover on. Coat the first end-paper (the one next the cover) evenly all over with thin paste, taking care to put on only enough to make it adhere. Close the cover on this pasted end-paper, and open it again, laying it back as before, when the end paper will be found attached to it. Smooth it well with the folding-stick to make it adhere all over, taking care to remove all wrinkles. Pay particular attention to the hinge, and press the paper well into it. Lay a pressing tin upon the end paper just pasted and turn the second or middle end-paper back upon the tin. Paste the third end-paper all over, lay the second on the top of it, and smooth it carefully with the folding-stick. Put the pressing tin between these two papers, pushing it well to the back, and shut the book. Turn the volume over on the other side, and fix the other three end papers.

The book should next be tied up. Get a piece of smooth cord and tie a small loop-knot at one end of it. Place the knot at the head and pass the cord along the groove at each side of the back, pass the end through the loop, draw it firmly, and tie a slip knot. The use of this cord is to press the canvas thoroughly into the grooves while the glue is soft, and to set the headbands. See that the latter nestle closely up to the canvas, and that it turns neatly over them somewhat like a hood. The knot on the cord must always go above the sections at the head or tail where it cannot make any mark (see Fig. 17). Place a pressing-board at each side of the book ending at the groove, for the back must not be squeezed at all. The book should be firmly screwed up in the press and left there for several days before removing the pressing tins or cords. The impatient beginner may take it out at the end of twenty-four hours for a hasty inspection, duly replacing it to finish out its time.

If the foregoing instructions have been faithfully carried out there should now be a strong, neat volume, very plainly whole-bound in canvas.

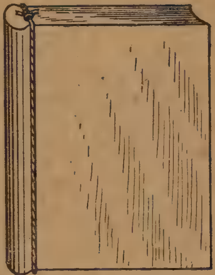


Fig. 17.—Book "Tied up"

The plan most frequently adopted by amateurs is to get the name put on the book by a tradesman, who will usually do it for a trifling sum. There are, however, other ways in which the difficulty can be got over, which do well enough for first attempts. For example, the name may be stamped on with an india-rubber stamp upon a small piece of thin white or buff kid, shaped neatly and pasted on the back of the book with thick paste. Some people write the name on with ink or good gold paint. On a thick book the name should go across it fairly near the top, while on a thin one it should run up the book from tail to head.

Another plan is to hunt for the title of the book among publishers' advertisements, and, when found, to cut it out and paste it on.

BINDING MAGAZINES

Preparatory Work.—The year's numbers of a magazine, for example, may be lying unbound upon his shelves, and he might wish to know how to make a volume of them. See that the numbers are complete and that they follow one another in proper sequence; lay them on the table in a pile to the worker's left hand, with the first number on top. Take up that number, remove the "wrapper" or cover, and cut all the threads, pulling them all away gently, or remove the wire staples, as the case may be. The staples require to be carefully taken out, or they will tear the paper; their ends should be raised to make them stand upright, and then they can be easily pulled out from behind.

Pull the sections carefully asunder, and lay them face downwards in their proper order at the right hand. Any coloured plates, etc., should be laid by themselves, also in order. Any advertisement sheets should be removed and kept as waste paper. Probably the last number will contain the title page and index, and these must be put into their proper places. Be on the watch for "dog's ears," and when found, straighten them out. When all the sections have been gone through, turn them over and replace them at the left side as before, with the first number at the top. Next, it is necessary to examine the folding of the numbers. The better-class magazines, as a rule, give no trouble, because they are for the most part carefully folded at the start before they leave the publisher; but in many of the cheaper magazines the folding is carelessly done, and has to be done again before any attempt is made at binding. Thus, one page may have a large margin above the headline, while the next has a small one; and the tail, of course, will also be similarly uneven. As far as possible, these headlines must be brought to the same level, and to do this it is necessary principally to attend to the head of the sections. When a very large margin is found upon a sheet at the head, cut a piece of it away with a pair of scissors, using the carpenter's square to keep the work straight. Perhaps there may be a sheet with a margin much smaller than the rest, and in this case the best thing to do is to touch the preceding sheet right in the middle of the fold with a pasty finger. The short sheet must be laid in with its headline at the right level, and the paste will hold it there. If this were not done, it would get out of register when the sections were knocked up. To be "out of register" means that the headlines do not correspond with one another in position.

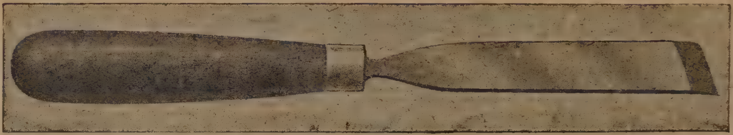


Fig. 18.—Skew Chisel for Cutting Book Edges

The margins at the sides have also to be seen to, as the fold in the centre of the sheet may be very crooked, and must be straightened. When the crookedness is very slight it is sometimes the lesser of two evils to leave it alone, because altering the centre fold will most likely bring the sewing marks into the inner margin. When re-folding a page, it can generally be brought straight if it is held up to the light, so that the worker can see the printing through. In some very carelessly printed magazines the register of the printing is bad; that is to say, the printing on the back of a leaf does not lie exactly under that on the front. This makes it impossible to fold the pages accurately, and the bookbinder can only do what he thinks best in such a case. The reason that all the above points must be carefully attended to is that when the folding is left to chance some of the printing is very likely to be cut away where the narrow margins occur.

Plates.—The plates, coloured or otherwise, have next to be seen to. If the margins are perfectly straight and square, and the plates are of the right sizes, they are easily managed; but should they be crooked or too large, they must be carefully measured and cut. They have then to be fixed in their places. The plates of a book are usually placed on the right hand, so that on turning over the pages they appear face upwards. This, however, is not a fixed rule, and a frontispiece, for example, is nearly always placed the reverse way. When the pictures are printed lengthwise on the paper the plates must always be placed so that the inscription goes to the right-hand side of the page, whichever way the plates face.

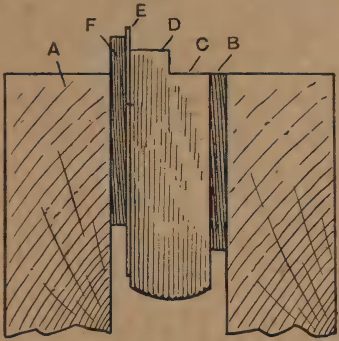


Fig. 19.—Book Edge in Course of Cutting

To fix a plate, lay it wrong side up and place a piece of waste paper upon it, leaving about $\frac{1}{8}$ in. uncovered along the back edge (the edge by which it will be fastened). Have ready some thick paste, dip the middle finger into it, and rub it along the exposed edge. Put the plate carefully into its place, and rub it down to make it adhere.

If the plates are coloured, some precaution should be taken to prevent their sticking to the opposite page. Some workers recommend rubbing them over with french chalk, and others that a leaf of oiled tracing paper be laid on them. If a plate does stick, do not try force, or both plate and page may be injured; instead, lay a piece of waste paper upon the plate, and pass a warm iron over it; this will soften the colours and enable the pages to be safely parted.

When all the plates are fixed, look over the numbers to see that the sections are complete and in their proper sequence.

Treatment of the Edges.—It will now be necessary to proceed as before described, making end papers, marking up and sewing. After the sewing is done, it will be observed that the edges are not so smooth and neat as those in the first book were, and they will need to be cut. Many amateurs take their books to a bookbinder's to be cut after the back is glued and before it is rounded, but it takes away half the pleasure of bookbinding to get all the little troublesome parts done by a tradesman, and it is much more satisfying to overcome all the difficulties as they arise.

With the press already described (see Fig. 4) and with a large skew chisel (see Fig. 18) it is possible to cut a book very well. This chisel should have a bevel on one side only—the one that is uppermost when the chisel is pointed to the left with the short edge towards the worker; but the other side should be perfectly flat. If the special chisel cannot be obtained, a broad wood chisel may be ground to suit.

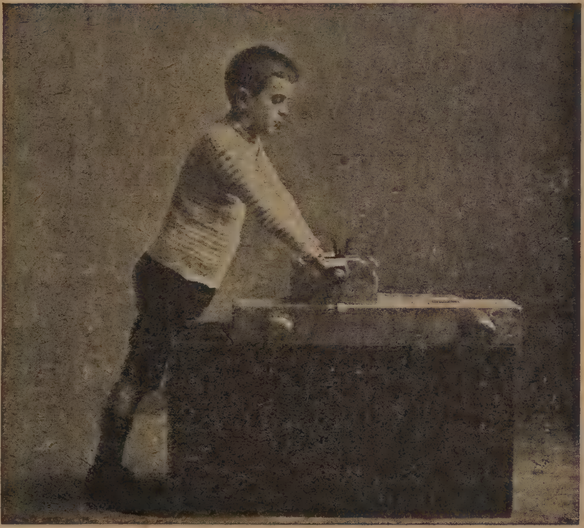


Fig. 20.—Cutting Book Edges with Plough

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Find out how much it is necessary to cut off the leaves of the magazine. The less that is cut away the better, for small margins are not so nice as large ones; but enough must be cut away to make the edges smooth. Draw a line accurately on the last end-paper along the head, showing how much is to be cut off. Knock up the head perfectly level, and hold the book so that the side next to the worker is the one upon which there is the guiding line; place behind it, first, a piece of waste strawboard and behind that a pressing board (the strawboard protects the pressing board). In front, lay a pressing board exactly along the guiding line. Lower the book into the press so that the pressing board B (Fig. 19) along the line is exactly level or flush with the cheek. The strawboard E and pressing board F at the back should rise higher than the cheek of the press A. Cut edges are shown at C and uncut edges at D.

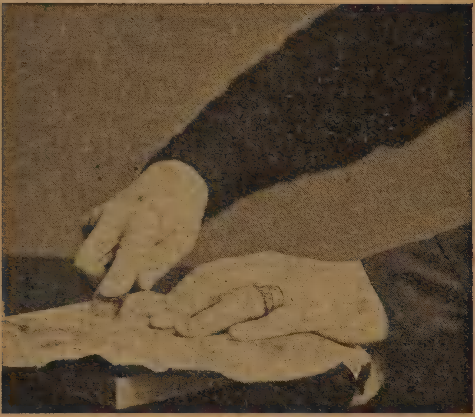


Fig. 21.—Paring Leather with Shoemaker's Knife

Stand at the end of the press with the fore-edge next to the worker and the guiding line on the right-hand side. Lay the chisel with its shortest side towards the worker, and the flat side on the cheek of the press. Start a little way beyond the back of the book to draw the chisel towards the worker, letting the sharp point pass along the side of the book. Repeat this over and over again, being content to cut a very little at a time, until the head has been entirely cut through. The chisel must be kept very sharp at the edge, and the work must not be hurried by trying to do too much at a time, or the leaves will be torn instead of cut. It is well to practise on something of no value. After the head of the book is cut, remove it from the press and mark a guiding line on the first end-paper at the tail. Knock it up again and put it into the press as before, but so that the tail may be cut. Afterwards, the fore-edge will need to be cut.

The foregoing directions are intended only for cutting with a skew chisel. With a proper plough—such, for example, as that shown in position by Fig. 1 on an earlier page—the cutting is done in a direction away from the worker instead of towards him, in which case the book is put the reverse way into the press. Fig. 20 gives an idea of the ease of the work.

The cutting being finished, the back should be rounded, and the binding proceeded with as already directed.

HALF-BINDING

So far, only whole binding with cloth or canvas has been considered. "Whole-binding" refers to a book cover made entirely with one piece of material. That may be cloth, leather, vellum, or other suitable material. Large books are seldom bound in this way, being for the most part done in what is called "half-binding," the back and corners being of one material and the sides of another. Leather for the back and corners and cloth for the sides are the favourite mixture. But leather is difficult for a beginner to work with, because it has to be carefully pared, or it looks clumsy, especially at the edges; and leather paring requires considerable practice. Small books look well with cloth backs and corners and paper or cloth sides of a contrasting colour; for example, cream for the back and light blue or green for the sides.

Half-binding is not more difficult than whole-binding, but great accuracy is necessary in cutting the different pieces for the covers. For half-binding, the book should be screwed up in the press with the back projecting half-way. The cover is then put upon the back very much as in whole-binding, but it goes only a little way down the boards. When the back is satisfactorily covered, the book is removed from the press and the corners covered, the sides being done last of all. The cloth for each side must be carefully measured and fitted, so that there is a slight overlapping where it meets the back and corners; there should be a ½-in. turn-in at the fore-edge, head, and tail where it goes over the edges of the boards. Books that have not separate pieces in the corners are more easily done.

Leather should be stuck on with thick paste, not with glue.

There is a kind of leather binding that does not require paring. It is a limp binding in which the edges are not turned in, the leather being merely cut away ¼ in. beyond the thick end-papers that are used instead of boards. In one instance, a book of this kind was effectively covered with suède leather, like that used for gloves, but this style is only suited to small fancy books which lie upon a table. Both suède and kid can be embroidered.

Leather Paring.—Although leather paring is a trade in itself, it is work that an amateur may find it convenient to do for himself in a small way. The first essential is to have the knife exceedingly keen. There are many different kinds of knives recommended for the work—the French knife being a favourite. The one used by the writer is an ordinary "leather knife," such as that used by shoemakers, and answers very well for paring margins. A piece of plate-glass, rounded at the corners and smoothed at the edges, makes an excellent slab upon which to rest the leather; but a piece of very hard wood, nicely smoothed, can be used if more convenient.

Odds and ends of leather can often be procured at an upholsterer's, and these do very well for half-binding; they are left over from the upholstering of leather-covered furniture, and as they are too small to be of any use to an upholsterer, they can be bought for a small sum.

Examination of the leather will show that it is too thick to be used without preparation. A book would look extremely clumsy if the edges were turned over without being pared; the parts also where the cloth and leather overlap should be thinned down, and such jobs are not beyond the skill of an amateur after a little practice; it would be different, however, if the whole under surface of the leather had to be removed, because, if the leather is not made perfectly even, every little ridge or hollow will ultimately show when the binding is finished.

When the pieces of leather are cut to their proper size for the back and corners of a book, the margins to be pared must be accurately marked on the wrong side with pencil lines. Hold the leather, flesh side uppermost, firmly upon the glass with the left hand. Hold the knife handle with the right hand, stretching the forefinger along the blade so as to increase the pressure; lay the blade almost flat on the leather with the edge turned away from the worker. Should the blade be placed on the leather at too great an angle, the material will be cut through instead of being shaved (see Fig. 21). It sometimes facilitates the paring to run a wet sponge over the leather.

The knife must be frequently sharpened, and it should have a very slight "burr" on the side which touches the leather. A "burr" is a turned edge, and this makes the knife grip the leather.

The paring should be done evenly and smoothly. To ascertain if the edge of a cover is quite smooth, fold it over on itself as it will afterwards be turned over on the board, and run the finger along the fold, in this way detecting at once any thick place that requires further paring.

It is an excellent lesson to take to pieces some old books that have been well bound. Such books bound in leather can often be bought for a penny or two at a second-hand bookstall; the matter contained in them is dull or out of date, but the binding has a special value to the student of bookbinding, who should attend carefully to the methods of sewing, of making headbands, and to many other things as he gently pulls them asunder. Do not be in too great a hurry, or many of the details will be missed. The end papers should be saturated with water, so that they may be peeled off the boards, as some of the lessons lie underneath. Thin paste will soften glue.

FINISHING

When an enthusiastic amateur bookbinder has turned out a few nicely bound volumes he no longer feels content to remain ignorant of the process of finishing his work. He would fain put on the names and do the ornamental tooling with his own hands. What usually deters him is the cost of the tools, because so many of them appear to be needed. It is, however, wonderful how many substitutes can be found for things that seem to be indispensable, and for that reason it is advisable to understand something about the work of finishing before buying the tools and implements.

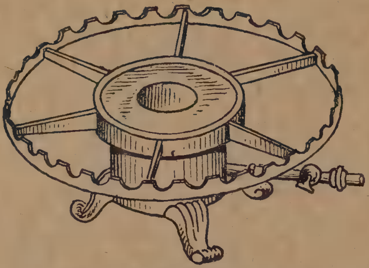


Fig. 22.—Stove for Heating Book-finisher's Tools

Finishing Tools Described.—Bookbinders' finishing tools are not so easily picked up in second-hand shops as the tools of other trades, probably because they usually belong to a firm and not to the tradesman himself. If the worker cannot afford to buy them new, the best way to get them is to advertise in a good exchange paper, and the best time of year to do it is in the summer, when that particular kind of work is apt to be exceedingly slack and many bookbinders in a small way are glad to sell some of their stock. Old and much-worn tools are not worth buying; the rounding off of sharp angles is sure evidence of wear. Do not buy tools that have been put out of order by rough usage and knocking about. Injury to the edge of a wheel spoils every impression made by the tool. Drop tools and rolls, also, should be carefully examined to ascertain that no injury has been done to the engraving upon them. As these precautions are very necessary, it is obvious that when obtaining second-hand tools the purchaser should always have them on approval.

Stove.—A stove of some kind is necessary for heating the tools (see Fig. 22). A proper finishing stove, either oil or gas, costs well over a pound. A cheap spirit lamp can be made to answer, but it has serious drawbacks, such as the need for frequent replenishing, which interrupts the work, and the cost of the methylated spirit. A "Primus" oil-stove would serve well if fitted with a distributor as described below. A small gas-ring, costing a shilling or so, can be adapted to be an almost ideal device. A Herdal heat distributor is placed on the top of it, this consisting of two perforated metal discs 7 in. in diameter, joined at the edge in such a way as to leave a slight space between them.

As the perforations in the two plates do not correspond with one another, the heat becomes evenly distributed over the whole surface. When the heads of the tools rest upon this plate, they are not overheated, inasmuch as they are not in direct contact with the blaze of the gas. In order to get the best results, the handles of the tools lie horizontally, and it is easy to arrange a gallery of some kind. An excellent one can be made by doubling a piece of strong wire netting and securing the ends together to make a ring, the depth of which will depend on the height of the gas-ring (probably 3½ in.), the diameter being about 12 in. (see Fig. 23). The scallops along the upper edge where the wire is doubled will keep the tools from rolling about. The gas supply tube can be passed through the wire netting. This arrangement answers quite as well as the best finisher's stove; it is not so neat in appearance, but it costs very much less, and it is certainly more convenient than the charcoal stove employed before gas became the vogue.

Bench.—In a workshop a finisher has the use of a bench, but a strong, steady deal table does quite as well.

Press.—A finisher's press is small and less powerful than the ordinary presses used in forwarding. It stands on the bench or table, and is easily manipulated. The home-made press shown earlier in this chapter by Figs. 2 to 4, with its four bolts to be screwed up, is rather cumbersome and awkward, but it can be made to serve.

Gilder's Tools.—A gilder's knife is useful, but a breakfast knife may be made to answer its purpose remarkably well; select one that is in good order, and not too sharp. A gold cushion costs a few shillings, but it can be easily made at home (see Fig. 24). Get a piece of smooth wood about 6 in. square and about $\frac{3}{4}$ in. thick. Lay on the top of it a single square of wadding, and on the top of that a square of good blotting-paper. Finally, cover with a piece of leather, putting the rough or flesh side uppermost. The writer cut a square of kid with no seam, large enough for the purpose, from the arm portion of a lady's glove.

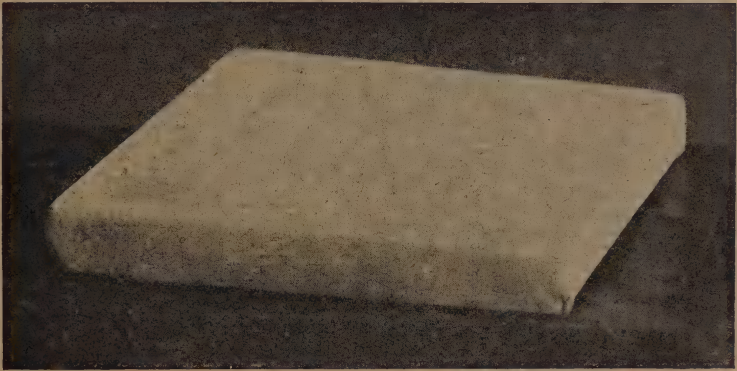


Fig. 24.—Gold Cushion

Fillet.— A fillet (Fig. 25) is a small revolving wheel of brass held by an iron fork fixed in a strong handle. Any book finished with gold tooling probably has lines of gilding running along the edges of the boards, and these have been made by means of a fillet. The lines may be thick or thin, or they may be in groups of two or three upon the same fillet. Fillets vary in size, one of average size being about 18 in. long and having a wheel of about 3 in. in diameter. A single-line fillet costs a good many shillings, and not much work can be done without it.

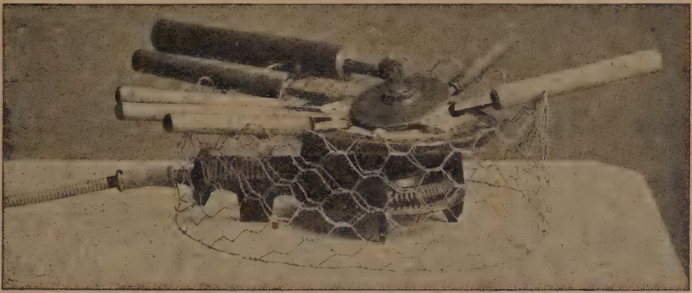


Fig. 23.—Improvised Stove

Rolls.—These resemble fillets, but have a broader rim, and instead of marking lines they reproduce ornamental patterns which are cut upon them. They are expensive, but the beginner may dispense with them.

Pallet.—This is a smaller tool than either the fillet or roll, and its face is a portion of a circle (see Fig. 26), and is so shaped as to impress the pattern which it bears upon the leather when it is rocked or pressed on the work. Any design that can be made upon a fillet or roll can be cut upon a pallet. The price of a pallet is roughly about one-third that of a roll bearing the same pattern cut upon it. A simple pallet, with perhaps a couple of lines, is useful to begin with (see Figs. 27 and 28).

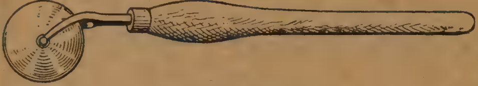


Fig. 25.—Fillet

Line Tools.—These are similar to pallets, but have single lines upon them. They are made in various sizes to suit the different lengths of line required. There should be at least one line tool of the same thickness as the fillet; it is used for finishing off corners where the lines meet. It is difficult to run a fillet exactly to the meeting point. Line tools are among those which an amateur can make for himself if he is willing to take some trouble.

Gouges.—These are tools which mark curved lines, and are made in sets for impressing various curves from quarter to whole circles. They are used in patterns which combine curved and straight lines (see Fig. 29). A beginner can do without them only if he keeps to very simple tooling.

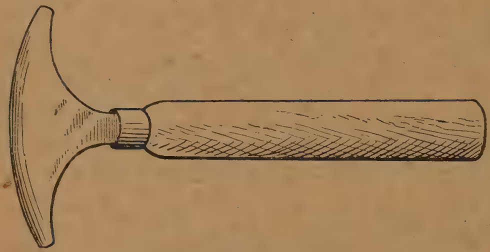


Fig. 26.—Pallet

Drop Tools.—These are made in endless variety; in elaborate tooling, a great many of them are necessary because every part of a design requires a separate tool (see Fig. 30). For a beginner, however, two or three carefully selected drop tools, the smaller the better, are sufficient. A drop tool is made upon a similar plan to that of an office seal, consisting of a piece of brass upon the face of which a design, more or less elaborate, is cut; the other end of the brass is pointed and inserted into a straight wooden handle.

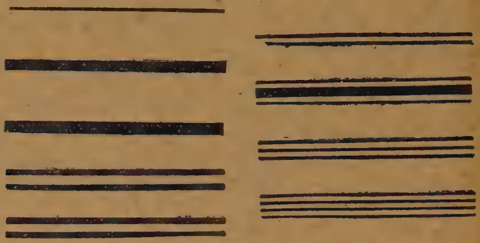


Fig. 27.—Pallet Lines

There is much pleasure to be derived from the building up of elaborate designs by the ingenious use of a few tools. For example, a corner design impressed four times makes a centre design; or a small flower placed at intervals at each side of a fillet line makes an elaborate branch, and so on.

Letters.—These are, of course, an absolute necessity for putting the names on books. One set of small capitals is enough to start with, and further sets can be added as they are required. Until a little experience accustoms one to the sizes of letters, it is better to select the desired size by looking at the titles of books, measuring the letters with dividers, and comparing with the printed letters in a tool-maker's catalogue. It is surprising how much larger the black printed letters look than when they are in gold on the back of a book. A set of letters with separate handles costs from 10s.

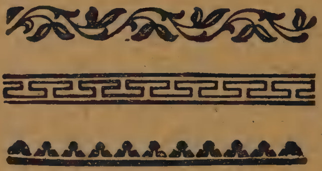


Fig. 28.—Pallet Ornaments

upwards, and contains a complete alphabet, ten figures, two stops, and the sign "&," thirty-nine pieces in all. It requires considerable practice to be able to put the name of a book quite straight with the separate letters, and for that reason many amateurs prefer to get a typeholder and a sheet of brass type, in which case many more letters are necessary.

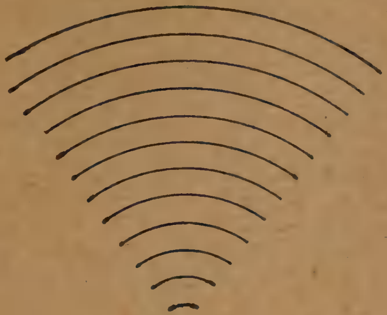


Fig. 29.—Gouge Lines

Home-made Tools.—Fig. 31 shows a group of home-made tools. A and B are a pair of small drop tools made of pieces of brass wire filed in shape. C shows a pallet, and D and E two line tools of different sizes. F and G are a pair of gouges made of half-tubes of brass. The line tools are made of brass sheeting. Brass wire is made in various sizes, some being as coarse as $\frac{1}{8}$ in. in diameter (11 B.W.G.). Two or three tools made of this wire in graduated sizes come in useful. They make spots which can be used in many ways; for example, a curve made with a gouge may be ended off with a spot in such a way that it becomes a scroll. Three spots impressed together in shamrock form make a foundation for many pretty designs; and so on. This tool of brass wire is the easiest of all to make; it merely requires one end to be filed to a point which is driven into a handle, while the face at the other end requires to be filed flat; the part projecting from the handle is about $1\frac{1}{2}$ in. long. The top should be filed off perfectly flat, smooth and even, and the slight roughnesses left by the file should be removed on an oilstone. The angle between the face and side is usually rather sharp after filing, and this must be blunted and made quite smooth, as a sharp corner would cut the leather.

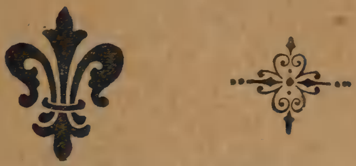


Fig. 30.—Drop-tool Patterns

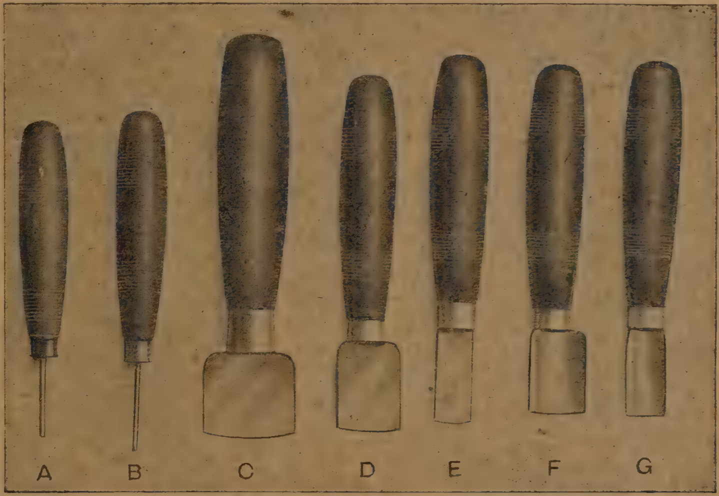


Fig. 31.—Book-finisher's Set of Home-made Tools

On a very coarse piece of brass wire a cross or a star can be filed—a file, care, and patience being the chief requisites for this job.

Gouges and line tools can be made of odds and ends of strong brass sheeting, such as can be bought at any brass engraver's; as these are only waste pieces, enough to make a dozen tools can be got for a few pence. Half-tubes are occasionally to be had amongst them. Very nice handles, provided with a brass collar or ferrule, are to be had from a penny each, so the outlay is not great. When brass tubing is not to be had, brass sheeting can be hammered into semicircular shape. The filing must be carefully and neatly done, so as to leave each tool of even thickness the whole way across.

The line tools should have the face with the slightest curve, so that they will rock, and all sharp edges or rough places must be rubbed off on an oilstone.

Gouges, as a rule, are used for very fine lines, such, for example, as the stems of flowers, and it is convenient to have a good set of them of different lengths and curves. They should be filed on the outside of the curve so that a bevel brings them to the required fineness. A beginner could start very well with one set of letters, one fillet, and the home-made tools mentioned above. Other tools might be added one by one, as they are required, such as a few flowers and some small leaves, which can be used in very many ways for building up designs.

Some receptacle for the safe keeping of the various tools should be provided. If the tools are knocked about together, the working faces are soon injured.

BLIND TOOLING

The amateur should begin with some blind tooling upon an old book of no special value, in this way learning how the tools are used. The worker will probably have (or can buy very cheaply) a few old books plainly bound in cloth and leather, which are of no value as far as their contents are concerned, and these will serve very well for experiments to determine the weight of pressure necessary and the proper heat of the tools. By the time their covers are almost hidden under a heterogeneous mass of impressions the worker will have learnt a great many useful lessons, and be ready to begin some simple blind tooling on a useful book having a cloth cover. It is not wise to attempt gold tooling until some skill and certainty have been attained in the use of the tools.

Before starting work it is necessary to gather together everything likely to be wanted. Attend first of all to the bench or table. Place it where there is plenty of light, and see that it is firm and steady. The stove should be in order, ready to light. Prepare a shallow vessel, such as the lid of a tin, with a small pad of wadding, and pour clean water on the pad, working the latter till it becomes quite saturated. This wet pad is to test the heat of the tools. A small piece of leather is necessary to clean the tools on, and it may, for convenience, be secured, flesh side uppermost, to a board. Some people use the side of the gold cushion for this purpose, but it is better to have a separate leather for it. Make a small piece of wadding slightly greasy with olive oil; merely wipe the oily cork of the bottle with it, because it should not be very greasy, and then rub it to work the oil into it; keep this at hand. Collect together the dividers, pressing tins, waste paper, strawboard, a small flat wooden rule of a cheap kind, and some scraps of old linen. Light the stove, and set the wheel of the fillet, and a line tool of the same thickness, to heat.

Place the book on its side with a pressing tin under the upper board. Take the dividers and screw them up to the width desired to be left between the line round the margin and the edge. Hold the dividers in a slanting position, with the hinge next to the worker and the right forefinger on the left leg of the dividers. Place the right point at the fore-edge of the board about 1 in. from the head, and press the left one down firmly, so that it makes a slight dint where the line is meant to come. Make a second dint about 1 in. from the tail, and lay the flat ruler down close to the left of these dints, Take the fillet off the stove and lay the wheel on the wet wadding; if it hisses very loudly it is too hot, but if it does not hiss at all it is too cold; a gentle hiss tells that it is the right heat for cloth. Run the wheel quickly upon the leather to clean it, and then grasp the lower end of the handle with the right hand, clasping it with the four fingers and thumb. It will be noticed that one side of the wheel is flat and the other curved; the flat side should be to the left. Press down the flat rule carefully in its place with the left hand, stretching the fingers so that both ends of the rule are pressed down. Rest the top of the handle of the fillet against the worker's right shoulder and run the wheel rather heavily on the book cover, and in contact with the edge of the rule. Begin at the end next the worker, and run it to the other end.

There should now be a clear line impressed upon the cover, and if it is not sufficiently deep the pressure has been too light; if it has gone crooked, the rule was not held sufficiently firmly.

It is difficult to begin and end exactly where it is wished to do so, but it is better to err on the short side, because the line tool can fill in what has been left out, whereas tool marks cannot easily be removed once they have been put in. When such an accident does happen, take a piece of linen, slightly wet it in clean water, wrap the right forefinger with the wet rag, and run the linen-clad nail along the superfluous line; this may possibly raise it again, but if the linen is too wet it will make a stain. The fillet should be on the stove while the correction is being made.

Beginners often find it difficult to remember to keep the tools hot, until they learn by experience that cold tools will not do any work.

Mark the three other lines with the dividers in the same way as the first, and run the hot fillet along them. Should the fillet be at all inclined to stick, rub the edge of the wheel with the greased wadding. Plan out a pattern composed of lines (see Fig. 32), marking the distances with the dividers, and practise working the fillet on them. Lines of blind tooling can also be run in much the same way with a pallet or line tool, using a ruler as a guide; near the end of the line the tool can be rocked so that the end of it marks the end of the line. A beginner often finds a line tool much easier to manage than a fillet.

Some finishers rub their tools across the palm of the left hand instead of on the greasy wadding, but this plan is not altogether to be recommended to a beginner, because if it is not done very rapidly, or if the tool is too hot, it may give a nasty burn; indeed, at first, a beginner is rather liable to get little burns, until he learns how to handle the tools.

A very good beginning has been made when a systematic habit has been formed of trying the heat of the tool, cleaning it, and then running a clear straight line neither too long nor too short, neither too heavy nor too light, but of even depth the whole way along.

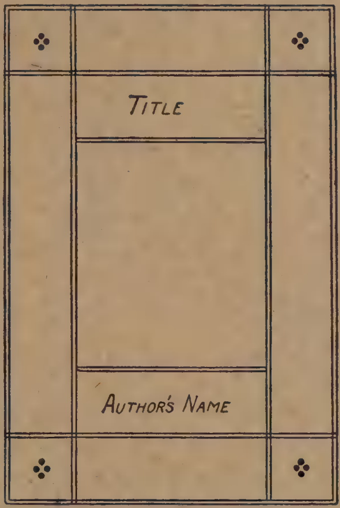


Fig. 32.—Line Design for Book Cover

Some of the lines in the pattern may perhaps look well ended off with the impression of a drop tool. The drop tools are heated and tested just as in the case of a fillet, and cleaned on the leather. It is not good for any of the tools to be overheated, but experience very soon teaches one how to regulate the heat of the stove. When the drop tool is ready, look for a sunk mark across its shank, this indicating the top of the pattern. These tools are usually made with a slightly curved surface, and so they must be rocked a little to make a clear and good impression. Most finishers rest the left hand on the cover, turning it over so as to be able to steady the drop tool with the thumb. Be careful to press the tool evenly all round; a beginner is liable to make the impression deeper at one point than at another.

For the back of the book the working of the tools is practically the same as for the sides, but the book must be firmly gripped in the press with the back projecting, in order to make that part convenient for work.

The tail of the book should be at the worker's left hand and the head to the right. The back of the book must be carefully measured with the dividers. Let it be supposed that seven single lines are to be run across the back with a pallet and that the impression of a drop tool is to be put in each space between. Mark the places for the lines at the head and tail. The head line should be $\frac{1}{8}$ in. and the tail line $\frac{1}{4}$ in. from the edge. For some reason it always looks wrong if there is not more space left at the tail than at the head. Divide the space between these two into six even portions, making a dint with the dividers in the centre of the back at each place where a line should be impressed. It is a matter of great importance that these lines should be absolutely straight; to have them slanting looks very bad indeed. There are various methods of getting them straight. A simple one is to take about a foot of some nice smooth twine, such as fine macramé cord, and to tie a cork at each end as a handle. Stand at the end of the press so that the tail of the book is towards the worker. Take a cork in each hand, lay the centre of the cord on one of the marks, so that it lies perfectly straight across the back of the book, and then saw it backwards and forwards a few times, in this way causing a faint glossy line across the back of the book. The process should be repeated on each mark made by the dividers. There now should be seven lines marked in such a way as to guide the pallet and keep it straight as it is run across the back of the book (see Fig. 33). Another way of marking these lines is to use a thick visiting card as a ruler, bending it to the curve of the back and running the edge of a folding-stick along it.

The pallet should be clasped firmly with the right hand and worked across the back of the book from the wrist only; the wrist should be the centre of the working motion.

The second space from the head of the book should be reserved for the title. Find the centres of the other five spaces, and make an impression of a drop tool upon each of them. This is a very simple way of finishing a book.

If binding two volumes of the same book it is necessary to be very careful to mark both exactly alike, so that the bands of tooling may run across at exactly the same level as they stand side by side on a shelf.

When making a line with a fillet, it should be observed that it is a dull line, whereas a line made with a pallet is somewhat glossy. The reason is that the wheel of a fillet merely presses down the cloth or leather as it revolves upon it, while the pallet or line tool moves along it, burnishing as it goes. To make a really good polish, such as is desired in blind tooling upon leather, the heated tool must be "jiggered"—a bookbinder's term, which means working a tool backwards and forwards. When a finisher wishes to polish with a fillet, he can do so by inserting a small plug of wood between the fork and the wheel to make the rotation cease. It can then be jiggered, and made to give a good polish. Some finishers use a tool called a creaser for line work. It has a heavy handle to rest on the shoulder, like that of a fillet, but it has not a wheel. When jiggering a tool, a beginner must be very careful to keep on the line, or there will be a double impression.

GILDING

Gilding on Cloth.—The book has still to receive its title, and this will afford a good opportunity to learn gilding. As the side is the easiest place to work on, a suitable place for a title should be planned on that part of an old book. It is always difficult, without long practice, to put the name on a book perfectly straight with separate letters. Quite the easiest way for a beginner is to place some thin white paper (very cheap note-paper does as well as anything) on a piece of waste strawboard, and with heated tools impress the letters on this as though it were a book. This process spoils nothing, and can therefore be carried out without any nervousness to unsteady the hand. Repeat it—no matter how often—until the letters are applied straight and nicely spaced. Then the paper is laid exactly where the impression is to go on the cover of the book, steadied by placing a weight upon it, and the letters are gone over again very carefully with heated tools, this producing an impression of the name upon the book cover. Remove the paper, and the cover is then ready for gilding.

Two or three articles are necessary for the gilding that have not yet been mentioned. First of all there is gold leaf. It is no economy to buy gold of inferior quality. Gold leaf is extremely thin and fragile.

Some glair, prepared from the white of an egg, should be made the day before it is wanted. Break an egg carefully, separating the yolk from the white. The yolk is not wanted, and a single speck of yolk in the glair would be detrimental. Whisk up the white till it froths up quite high, leave it for some hours, strain off the clear part through muslin, and bottle it. This is glair. Half the white of an egg is quite enough for a first attempt. Glair does not keep very long, and when it becomes offensive it should be thrown away.

With a camel's-hair brush apply a coat of the glair over the impression of the letters made on the book cover, and allow to dry, but not to get hard, before the gold is put on. While it is drying the gold leaf should be got ready, and the letter tools should be heating on the stove.

In order to prevent disaster in handling the gold leaf, remember not to work in a draught, because the least puff of wind may destroy the fragile leaf; remember, too, that the leaf will adhere to anything the least bit greasy. Do not try to pick it up with the fingers, because it will inevitably stick to them. Even on freshly washed hands there is quite enough natural grease to cause the gold leaf to adhere. In order to be quite sure that there is no grease on the gold cushion, give it a slight rub with bath brick; and lest the knife blade may have been touched with greasy fingers, it should also be cleaned with bath brick immediately before using. The knife is all the better for being rather blunt, because a sharp one would cut the leaf on the cushion.

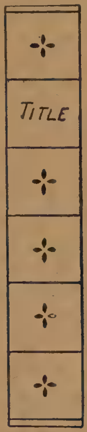


Fig. 33.—Simply-tooled Back of Book

When all is ready, bring the book of gold leaf close to the cushion, and transfer a square of the leaf to the cushion—an operation by no means so simple as it looks. Some people lift up the whole book and turn it over on the cushion. Another and a better way is to slide the knife well under the right-hand edge of the leaf all along it so that the point projects at the other side, lift the leaf up gently, and lay it on the cushion. If the leaf is crumpled, breathe on the very centre of it gently, holding the head right over it, for a sideways breath will only do mischief. If the leaf does not lie flat, do not touch it with the fingers, but use the knife carefully. A sigh of satisfaction at getting the gold leaf properly on the cushion may cause the leaf to fly off; and for this reason it is desirable to have a guard round the cushion.

When the gold leaf is in order on the cushion, cut a piece of it large enough to more than cover the place where the name is on the book. The cutting is done by gently sawing it with the knife. Rub the letters with a slightly greasy pad of wadding, so that the gold may stick to them. Make a pad of wadding about the size of the gold to be lifted, and rub the pad on the hair of the head to make it very slightly greasy; lay it very gently on the piece of gold leaf, which will immediately adhere to it, so that it can be lifted and laid on the lettering, where the grease will catch it. Press it well into its place with the wadding pad. Should a broken place have come in the gold, breathe on it and lay a new piece on the top of it, pressing it home as before. Next it is necessary to go over the impression of each letter again with its own heated tool, and when all have been successfully gone over the loose gold is rubbed off with a linen rag and afterwards with a very soft piece of indiarubber. Examine the letters carefully to see if they are all bright and clear. The chances are that some gold may have got scraped off with the edge of a tool or that the worker may have inadvertently pressed the gold on a wrong place, so that it comes where it is not wanted. In the latter case the judicious use of the point of a penknife may remove the extra gold. In the former case the letter may be again coated with glair and a fresh piece of gold put on the top of the bad letter and tooled as before.

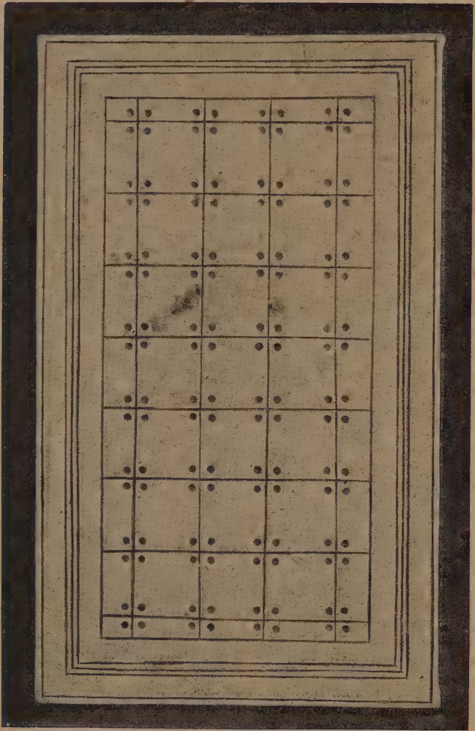


Fig. 34.—Design for Book Cover

Before any certain work can be accomplished, the finisher must have acquired the knack of dropping the tool quickly and accurately upon the desired spot, and with a proper amount of pressure. The tool gets cold in the hand of a slow worker, and then the gold does not adhere. If the impression is not sufficiently deep, and has to be gone over a second time, there is danger of a double impression, which looks very bad. A tool must not be overheated, or it will burn the cloth or leather, or at least it will dull the gold. Self-possession, quickness, extreme neatness and accuracy are the qualifications needed to make a good finisher, and truly they are qualifications which take much time and much practice to acquire.

The name has still to be put on the back of the book. To do this, the book must be put into the press with the head slightly raised so that it will be convenient to work at it standing at the end of the press. Prepare the place as before with glair; leave it to dry, and then rub it with the greasy wadding. Measure very carefully the size of the space and the size of the letters with the dividers, calculating accurately how to space them. Suppose the title consists of but one word—"Byron," for instance. It must go a tiny bit higher than the centre of the space to look right, and the letters must not be crushed together in such a way that there is a great space at each end. Lay on a piece of gold, measure at each side where the top of the letters should come, and just above that mark a line in the gold with the knife as a guide. Find also the centre with the dividers and mark it. Take R (the middle letter) off the stove and put it right in the centre. Then take O and next N, placing them to the right of R. Put Y to the left and last of all the B. By starting in the middle and working to either side, there is every likelihood of putting the name evenly in the space. An observant person can learn a great deal about putting titles on books by studying those in his possession. When a title contains many words the more important ones are usually put in the largest type. Small words, such as "of," "the," "for," etc., are often given a line to themselves, in smaller type than the rest. These, however, should match the style of the other letters, because a mixture of styles does not look well. The author's name is usually put in type a degree smaller than that used for the important words in the title.

As a rule, the lines in a title are of different lengths. One, for example, that occupies three lines does not look well if those three lines are all of exactly the same length. The long lines look better with short ones between.

The title of a book can be arranged upon paper for the back, just as described for the side of the book. The impressions should be arranged on a piece of paper long enough to reach the press or pressing boards at each side of the book. It can then be secured to these with a little thick paste so that it will not become displaced.

A beginner who starts with only one set of letters cannot follow all the above rules, but when he comes to purchase a second or third set he should see that these match the first in style. It is only those who can have four or five sets of letters who can afford to have a mixture.

Elaborate gold tooling is rarely put by hand on a cloth-covered book, but occasionally lines of gilding may be added with a fillet.

To put on gold with a fillet or roll, cut some gold leaf into convenient strips, heat the fillet as usual, and clean it and run it quickly on a piece of slightly greasy leather; then run on one strip of gold after another as it lies ready on the cushion, until there is a complete circle of gold on the wheel. Then run the gold-covered fillet, using considerable pressure, along the line to be gilt. Of course, every part of the binding to be gilt must be previously prepared with glair and then rubbed with a greasy pad to make the gold adhere.

When the tooling is finished, it greatly improves a cloth-bound book to rub it over with a thin coating of bookbinder's varnish. Various recipes are given for making this varnish, but it is much better to buy it ready-made. It is applied with a small piece of sponge.

Tooling and Gilding Leather.—The tooling of leather is much more interesting work. As a rule, in hand work, cloth is only given a very small amount of simple blind tooling, it being generally out of keeping to do elaborate gilding upon it. Tooling upon leather may be much more elaborate, due regard being paid to the nature of the book itself. Even half-bound books often have a considerable amount of gold upon their backs.

Tooling upon leather requires a great deal of experience, because different leathers demand such different degrees of heat; what would burn one kind would be just right for another. Cloth takes a hotter tool, as a rule, than leather. For cloth there should be a gentle hiss when the tool is laid upon the wet pad, but for some leather the tool should not hiss at all. A beginner should jealously guard all the scraps of leather left over, and use them for experimenting upon, and so learn the amount of heat necessary for each kind. Another difficulty in leather work is to gauge the proper amount of preparation necessary for each piece of leather, some leathers being porous and others non-porous. Morocco is non-porous, and needs only to be washed over with paste very much diluted with water, left to dry, and given one coat of glair. Porous leathers, such as calf, sheep, or russia leather, require to have thick paste well rubbed into them as a filling, this being then washed off with a sponge wetted in clean water. As soon as the leather is dry, it should be coated with size, and when the size is dry the book should be glaired one or more times, as may be necessary.

There is yet another thing in which leathers differ, and that is in the amount of pressure necessary to make a proper impression upon them. Some leather is soft and yielding, while another kind may be very hard and difficult to tool.

In the case of hard leather, it becomes easier to tool if a clean sponge is wetted in water and passed over its surface. It should not be wiped in any way, as that would make it streaky; if it is left to itself, the leather will likely absorb the moisture in a very short time, leaving it merely damp. Only relatively cool tools should be used with damp leather, as it burns much more easily than the dry material. All the beautiful blind tooling in which the tooling shows up glossy and dark against the untooled leather is done by careful management of the wet leather. It requires a great deal of practice to do this blind tooling with one uniform dark colour appearing over the whole design.

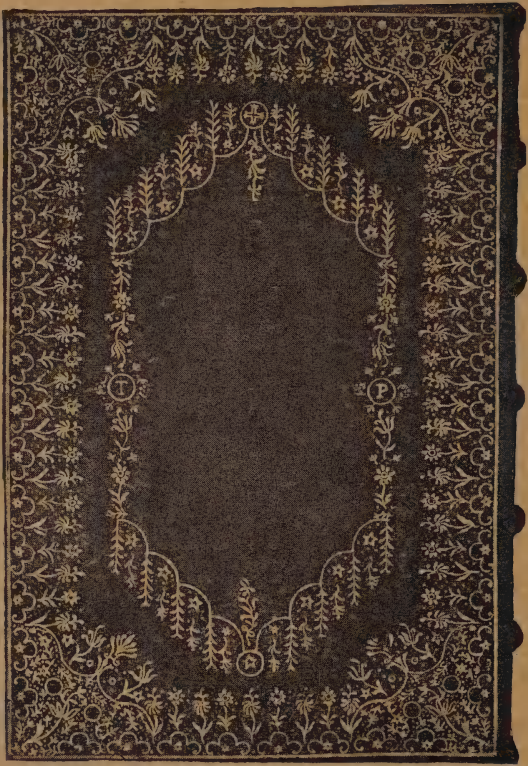


Fig. 35.—Elaborately Tooled Book-cover Design formed by Repeating Simple Elements

These directions sound simple enough, but, for all that, many years of experience are necessary before a finisher can apply them to each particular piece of leather in such a way as to get the best results.

For practice, it is an excellent plan to cover oblong pieces of strawboard with waste cloth or leather, and to use these for learning how to manage the various tools, working upon them as carefully as if they were the boards of a book, measuring and marking them with divider and folding-stick to keep the design accurate.

All-over designs can be planned out on paper by ruling four lines on it to represent the fillet lines along the margin. The space inside these can then be divided with pencil lines into oblongs, squares, or diamonds, as may suit the sizes of the tools and the way it is designed to space them on the cover. These pencil lines should be used as guides for impressing the various tool marks which go to form the pattern. When the design is satisfactorily arranged, it can be fastened to the book cover with a tiny speck of paste at each corner, and the design can then be blind tooled through the paper.

Fig. 34 shows a design which can be blind tooled with a home-made line tool and a spot tool. It should be all carefully measured with dividers and the lines marked with a folding-stick, or it may be planned out upon paper. To gild the design it is advisable to have a fillet. It is very difficult to put gilding upon long lines with a line tool, allowing of only a short piece being done at a time, without making uneven places, and also it is slow work to gild in such a way. A design such as this gives great practice in dropping a tool accurately upon a given spot, an accomplishment which a beginner takes some time to acquire. The design may be varied by using a small leaf instead of a spot.

Size has been mentioned as a necessary material for preparing leather. It can be made as follows: Simmer gently together for about an hour 1 pint of water, 1¼ oz. of isinglass, and a teaspoonful of powdered alum. Strain the liquid through muslin and use warm.

The foregoing instructions should enable a beginner to add a little simple tooling to the books he has bound for himself. That they pretend to describe the whole art of tooling and finishing is not for a moment to be imagined, for large volumes could be written on the subject. As it takes years of constant work to turn a tradesman into an expert, an amateur must not expect that by spending a few hours occasionally he can learn to do anything at all noteworthy. The work, however, is very fascinating, and it is well worth while. Fig. 35 represents an example of advanced work, which, however, in its elements is of quite simple nature.

Cleaning Book Covers.—To clean up calf or morocco covers of books, the following method may be employed. Procure a piece of Para rubber; if this is not soft, heat it over the fire or gas flame, for hard, square edges produce scratches on the covers. With this rub over all the gilding on the backs and sides, gently at first and a little harder afterwards; this should make the gilding clear and bright. Now prepare some paste-water, mixing flour with water till it is as thick as good milk, and apply this with a sponge. Wash over the leather, taking care not to touch the cloth or gilding.

To clean the cloth sides, beat up in a dish the white of an egg until it becomes a solid mass of dry-looking froth; allow this to settle into a clear amber-coloured liquid, and with this wash over the cloth. Have plenty in the sponge and work quickly in a circular motion, taking care not to go over the same part twice. For some cloths a weaker solution must be used, so add as much water as will make twice the quantity. If this glair is not properly beaten up, the parts of the book to which it is applied will when dry have a nasty glaze which will turn white and so spoil the appearance.

To remove scratches in morocco, if the skin is not broken, damp the part with hot water, and beat with a clothes-brush, holding it by one end and beating with the point of the other; this will raise the grain, and, if the scratch is slight, it will be hidden effectively. If not, while still damp, with the point of a fine needle carefully lift the leather in the scratch, working with the grain, and afterwards damp again and use the brush in the way already advised.

If the skin is broken, pick up with the needle all the edges of the scratch on both sides, rub in a little thin paste, and lay down the edges, using the needle so that each little piece may be carefully replaced in position. Rub off any surplus paste with the sponge. When dry go over it with the needle, stroking where necessary in the direction of the grain of the morocco.

For calf, instead of the needle and brush use a bone folder or the handle of a tooth-brush. Damp the part first with hot water, rub on a little paste with the finger, and rub well with the folder, taking care to keep it flat or more marks will be made. Wash again and allow to dry. Repeat the operation if necessary. If the skin of the calf has been broken, the method of pasting down must be employed, using the folder instead of the brush.

Renovating Iron and Brass Bedsteads

First, it will be necessary to remove all the brasswork, and wash it with or in a strong and boiling solution of common washing soda until all traces of lacquer are removed. As each piece is taken from the soda water, it must be thoroughly swilled in clean water and then dried near a fire. Where corrosion has fairly set in, rub it first with finest emery-cloth, continuing until all the corrosion is removed. Remove the marks of the emery-cloth with Monkey Brand soap or similar substance. The finishing touch may be given with a little rouge on a soft cloth.

Lacquer is best obtained ready mixed, and should be applied with a large camel-hair brush, the work being heated before the lacquer is applied. The long rods can be slipped on the spout of a kettle, and if the water boils quickly the heat will soon be sufficient to allow of the lacquer being applied. Dip the brush in the lacquer, and squeeze out all surplusage by drawing the brush across the edge of the basin; then, with steady, light strokes of the brush, work up the desired colour, Do not handle until cold. The small work can be placed on a hot-plate and then held in pliers while the lacquer is applied.

With regard to the ironwork, thoroughly clean off the whole of the old paint with a shavehook or other tool, then rub down the iron perfectly smooth with fine emery-cloth. Make a quantity of one of the following mixtures: (1) Ivory black and shellac varnish. (2) Melt ½ lb. of asphaltum, and add 1 lb. of hot balsam of copaiba, and when mixed, thin down with hot oil of turpentine. (3) Grind ivory black very smooth with turps on a marble slab with a muller, and add copal varnish till the paint is of the proper consistence. Apply the varnish by means of a camel-hair brush. About three to five coats must be given, each coat being dried in an oven heated to about 300° F., and if possible the heat must be gradually increased, but not to such a point as will calcine the paint. Polishing is done by rubbing down with a piece of felt dipped in tripoli or very finely powdered pumice-stone. Towards the end of the rubbing add a little oil, and when the work appears bright and glossy, rub with oil only. Finish off with a soft cotton or silk duster.

An amateur can often arrange with a cycle enameller to stove the work for him. Good air-drying cycle enamel is the best substitute for the stove-dried japan varnish when an oven is not available.

Easing and Draught-proofing Windows and Doors

"DOORS are made to shut, windows to open." They should shut with ease, without banging, pushing, or scraping; and open without having to pull or strain.

It is a common trouble for windows to be difficult to open, the cause generally being that paint has stuck the sashes fast. The dusting or cleaning previous to painting a window should be very thorough, as otherwise the paint may remain sticky for years and be constantly giving trouble. Sticking most often occurs at the upper part of the casing where the top sash closes, or between the bottom rail of the top sash and the top rail of the lower one. It is well to have windows open as much as possible for several days after being painted.

In cases where the two sash rails across the middle of the window are stuck together it is often possible to separate them by forcing the point of a screwdriver or chisel between them. They part with a cracking sound. If that is not sufficient, the tool may be inserted an inch or so down at the side of the sash, where the cord is, on each side. If that does not free the sash, the tool should be driven in under the sash at one corner, from the outside of the window, and then at the other corner, so as to prise or lever it up. If it is not convenient to get at it from the outside it must be done at the inside, but it will be necessary to drive the point of the tool into the wood of the lower sash rail, unless the casing bead is taken off. The same applies to the top sash, but it is rather more awkward to manage.

Careless use of the screwdriver or chisel may result in damage being done to the woodwork. To avoid the risk of this when freeing sashes that are stuck together, and in cases where the sticking is not likely to be very great, it is better not to use pointed tools, but to lean a piece of batten on the bottom rail of the top sash and to strike the other end of the batten a smart blow with a hammer (see Fig. 1). The shock is frequently sufficient to overcome the resistance.

Having freed the window, to prevent it sticking again the sticky paint should be rubbed with a rag and turpentine, or it may be scraped off and the places rubbed with black-lead and tallow.

A properly balanced sash should run quite easily, even if it is a large, heavy one. Large windows are usually glazed with plate glass, and sometimes, when they get broken, they are re-glazed with sheet glass for the sake of cheapness, but afterwards they give continual trouble unless lighter sash weights are put in.

The accumulation of thick paint owing to repeated coats causes windows to work stiffly. The best remedy for this is, obviously, to clean off the old paint before re-painting; but, in the meantime, if the sashways are examined, any lumpiness or rising will show rubbed, and may be scraped level and rubbed with soap. If the sash is too tight between the division beads and the casing beads, the latter may be taken out and planed on the inside or let back a little to give the sash more play. In any case, it is well to oil the pulleys occasionally. It helps the sash to run easily and prolongs the life of the cord.

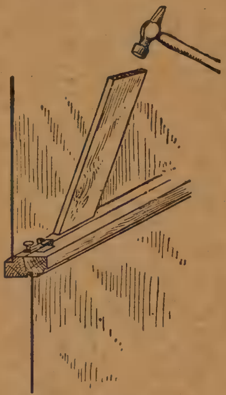
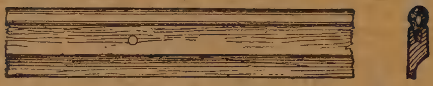


Fig. 1.—Loosening Top Sash with a Smart Hammer-blow


Figs. 2 and 3.—Draught-proofing Slip

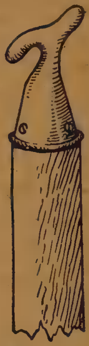


Fig. 7.—Polehook

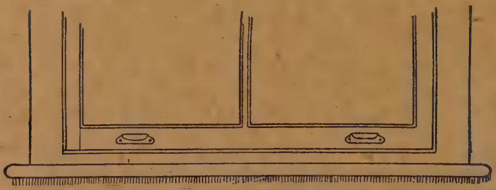


Fig. 4.—Sash-lifters Screwed to Sash

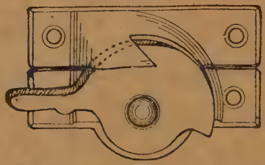
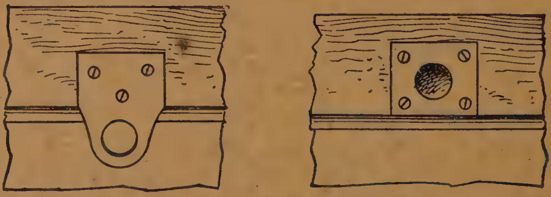


Fig. 8.—Malleable-iron Sash-fastener


Figs. 5 and 6.—Two Kinds of Sash-rings

When windows are too loose, they rattle and are draughty; the remedy is to re-adjust the beads or to insert draught-proofing slips, these being thin wood beadings edged with felt or rubber (see Figs. 2 and 3) which are fixed with small screws to the beads, the rubber edge being against the sash framing. These slips are useful for any kind of windows or doors, and act as "silencers" for banging and rattling.

It is an advantage to have "sash-lifters" and "sash rings" for convenience in opening windows, and to avoid soiling the paint-work. The "lifters" must be screwed on at equal distances from the lower corners, from 6 in. to 10 in. according to the width of the sash, so that the force in lifting can be applied equally (see Fig. 4). The sash-rings must be put in the exact centre of the top rail. There are two kinds. The pattern shown by Fig. 5 will not pull down right past the lower sash unless the screw-plate is let in flush with the wood. The other (Fig. 6) is made to sink into the rail. A pole-hook (Fig. 7) is required for pulling down and pushing up the top sash, and if an ordinary cup-hook is put at the edge of the window framing to hang it on, it will always be handy and out of sight behind the curtains. The type of ring shown by Fig. 5 is easily seen for hooking, but is sometimes objected to as catching the fingers when cleaning the glass. For windows of more than average height the ring and pole are very necessary.

Another matter that often requires attention is the replacing of sash fasteners. Some little care must be exercised in removing broken fasteners, as there is danger of breaking the glass. Of the scores of different patterns of fasteners, one of the best and cheapest is that shown in plan by Fig. 8. It is of malleable iron and serves the purpose quite as well as some that cost three times as much. A disadvantage of the ordinary brass fastener is that often it can be forced back with the blade of a knife from the outside, but this does not apply to the fastener here illustrated. It is advisable to varnish or paint it to prevent rusting. In putting on any kind of fasteners, a point to be observed is that when the catch is closed it should eliminate any crevice between the rails of the two sashes. If brass screws are used they will be the more easily removed when a new one is required.

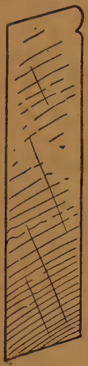


Fig. 9. — Ventilation Board for Window

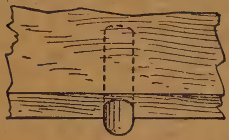


Fig. 11.—Dowel Pin on Ventilation Board

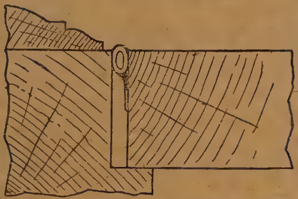


Fig. 15.—Edge of Door with Draught-proofing Slip

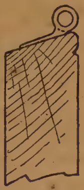


Fig. 12.—Draught-proofing Slip on Top Edge of Ventilation Board

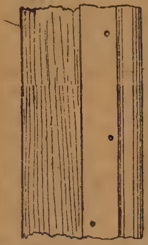


Fig. 14.—Draught-proofing Slip on Edge of Door

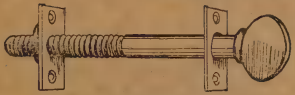


Fig. 13 —Thumbscrew Fastener

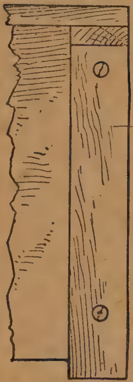


Fig. 10.—End of Ventilation Board to Fit Between Beads

Where an open window is objected to, but an upward current of fresh air is desired, the lower sash may be supported open by a piece of board, the space between the two sashes then serving for ventilation. The board should be 3 in. to 6 in. wide and 1 in. thick, and the length of the lower sash rail, and should have its edges planed slant to fit (see Fig. 9). It is placed in between the beads, and the lower sash closes down upon it. To secure it, a small bolt may be put at each end, or slips may be screwed on, as in Fig. 10, to make the ends of a thickness to fit between the beads of the sashways. The board is put in place or taken out as required, and sometimes it is convenient to have two dowel pins on the lower edge, about 6 in. from each end (see Fig. 11), to fit corresponding holes just behind the bottom casing bead. Sometimes a ventilation board is required to be permanent, and in that case it should be the thickness of the sash (usually 2 in.) and without pins, slips, or bolts. It should not allow of slits through which fierce draughts can come, and should therefore have rubber draught-proofing tacked on the edge, as in Fig. 12, and the tacked edge may be painted. The boards should, of course, be painted to correspond with the woodwork both inside and outside.

When a ventilation board is in place, the fastener on the sash rail is useless, but thumbscrew fasteners (Fig. 13) may be fixed one at each top corner through the lower sash, into the lower corners of the top sash. These fasteners are often put to windows in addition to the ordinary ones, to give extra security.

Doors that will not properly close or open should first be examined at the hinges. If they happen to be loose they may require larger screws or the holes to be plugged up and the same screws re-inserted, and the door may then be all right. But it may stick at the closing edge. In most cases it is not necessary to plane off the painted edge. If there is a space of $\frac{1}{8}$ in. or so at the hinged edge the door may be taken off and the hinges let in a little deeper; or, if absolutely necessary, the back edge may be planed. In many cases the closing edge cannot be planed unless the lock is set farther back, which involves altering the keyhole.

When the lower edge of a door requires to be planed or sawn to clear a carpet, it should be marked accordingly and then taken down by removing the screws from the post side of the hinges. For a thick carpet sometimes about $\frac{1}{2}$ in. has to be sawn off, and if the carpet does not come right up to the door, a "draught-excluder" becomes necessary. There are several makes to be had from most hardware stores, with instructions on fixing them. When the draught space is but slight, the rubber proofing may be put on.

In some cases it is necessary to put proofing on three edges of a door. The tube of the proofing should be about even with the inside corner of the door edges and tacked on as shown by Fig. 14 (p. 149), so that when the door is closed the tube will be jammed, as in Fig. 15 (p. 149), to close up the opening. Unless it is neatly put on, it spoils the appearance of a well-finished door, but when well done and painted to match it does not look bad, even on a white-enamelled door.

A later chapter will explain how to renew the cords of sash windows.

Removing Bottle Corks and Stoppers

Removing Corks.—For removing a cork that has fallen right into a bottle a string or wire loop is often used; insert the loop, invert the bottle, and, the cork being in a likely position, pull the string. A special appliance for the purpose is easily made from wire about $\frac{1}{16}$ in. thick. Two or four wires are twisted together, a loop made at one end, to serve as handle, while at the other end the wires are opened out and bent to form small hooks, all pointing inwards. It is pushed into the bottle and the latter is turned upside down. The cork then falls between the hooks, and may be withdrawn.

To remove a cork broken off in the neck of a bottle, two thin blades can sometimes be slipped in—opposite one another and between the cork and the bottle—and the cork removed by a combined twisting and pulling motion, the blades being tightly gripped.

Removing Stoppers.—Place a few drops of olive oil between the stopper and the mouth of the bottle or jar, then stand it in a pan of cold water; heat the water slowly until it is nearly boiling, then allow to cool. Some of the air will escape from the jar on heating, and the oil will be drawn in when the jar cools down again. If the stopper is not yet loose, apply side pressure to it with the thumb, and tap smartly but not heavily with a piece of wood. Do not put the jar into hot water, or the glass will probably crack; and do not use metal in place of wood for tapping the stopper.

Another method is first to make the jar cold, and then to warm the neck as quickly as possible—say by friction with a strip of cloth or by wrapping round the neck a rag that has been wrung out in hot water. The sudden expansion of the glass may loosen the stopper.

Barometers: Renovating and Making

THE barometer, as its name implies, depends for its action on the weight of the atmosphere, which varies under different conditions. Torricelli, in 1643, discovered that when a long glass tube, sealed at one end, was filled with mercury and then inverted, the open end being placed in a dish of mercury, the column in the tube sank until its surface was about 30 in. above that of the mercury in the dish. In this apparently unimportant fact originated that simplest yet most useful of scientific instruments, the barometer.

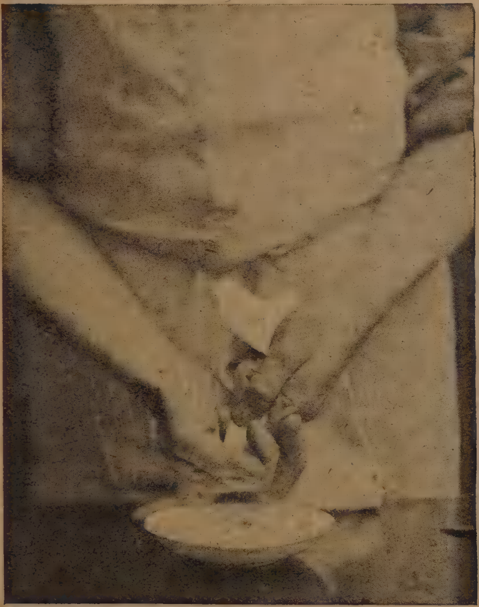


Fig. 1.—Cleaning Mercury by Squeezing through Bag

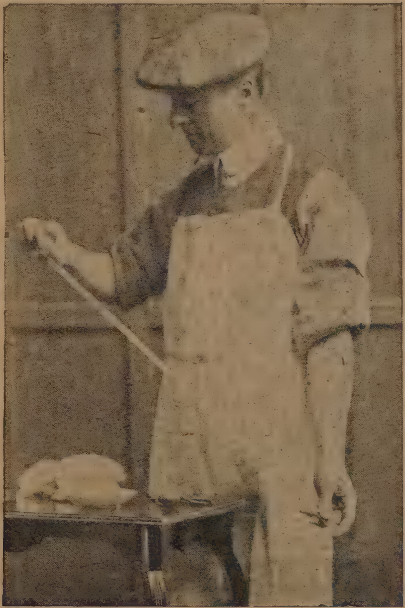


Fig. 2.—Shaking Mercury down a Barometer Tube

Types of Barometers.—Of the forms of the mercurial barometer in general use, the "cistern," the "Fitzroy," and the "Wheel" are the best known.

The Fitzroy is perhaps the simplest, as it consists only of a siphon tube, with a scale to mark the rise and fall of the mercury. It was introduced by Admiral Fitzroy, who also immortalised the quaint couplets which appear on the instruments bearing his name: "Long notice, long last. Short notice, soon past," and, "Quick rise after low, foretells a stronger blow."

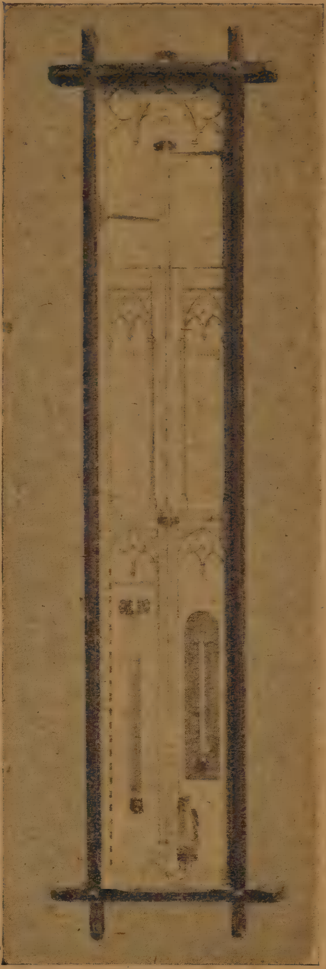


Fig. 3.—Fitzroy Barometer

The cistern barometer is reliable, but is not so often met with as the others. In this pattern the tube is inserted into a cylindrical reservoir, which is closed at the lower end by a diaphragm of soft leather.

The wheel barometer is a familiar figure in most homes, but is not absolutely accurate. The float which operates the registering hand is generally a little sluggish in its movements, and for this reason the hand moves a small distance, one way or the other, when the case of the barometer is tapped. This is the most elaborate of the mercurial barometers in common use, and generally possesses, in addition to the usual circular dial and thermometer, a hygrometer, which seldom works, a "warranted correct" spirit level, which is rarely horizontal, and a convex mirror, which is of no value, except to cover part of the long stretch of case which hides the 30-in. tube.

In recent years, the mercurial barometers have been largely superseded by the aneroids. The great advantage of these is their portability, the tube of mercury being replaced by a thin metal box from which the air has been exhausted.

Renovating Fitzroy Barometer.—Fig. 3 shows the commonest form of the Fitzroy barometer. In this particular instance it will be seen that the mercury in the tube is divided by little air bubbles. This is a common enough fault, generally caused by careless handling, and it makes a correct reading of the instrument impossible. To put this right it will be necessary to proceed in the following manner. First remove the top of the case, which is usually secured by two or three screws; then lay the barometer on its back, being careful not to spill any of the mercury, and slide out the glass front. The three thin brass straps that hold the tube in place are fastened by little brass nails. These may be levered up a short distance with the aid of a pocket-knife, and then taken out with a small pair of pincers. Straps and nails being put in a safe place, lift out the tube, holding it at each end. If the mercury looks dirty it should be removed from the tube and cleaned.

To empty the tube the mercury in the bulb should first be poured into a saucer. Now, holding the tube in a slanting direction, gently shake the remaining mercury down into the bulb. Keep on doing this, with an end-to-end movement, and pouring it into the saucer, until the tube is empty. The tube may now be put aside until it is wanted again. It is scarcely necessary to say that great care must be taken not to break it, the bulb especially being very fragile.

To clean the mercury, take a strong, clean linen handkerchief or a piece of new washleather, lay it in a saucer, and pour the mercury into it. Now gather up the loose part of the handkerchief or leather with the left hand, allowing the mercury to pull it down into a kind of bag. Grip this firmly just above the mercury, in the bend of the thumb and forefinger of the right hand, as shown in Fig. 1 (p. 151), and move the hand slowly downwards.

The mercury, being unable to escape upwards, filters through the handkerchief or leather, and pours into the saucer in a little silver cascade.

The tube should now be cleaned as far as possible, and the mercury replaced. To do this, empty the saucer of mercury into a small, clean cardboard box-lid, and pour a little into the bulb from the corner of the lid.

Now press the thumb over the top of the bulb, as in Fig. 2 (p. 151), and shake the mercury down into the tube. This operation must be repeated until the tube is filled. Under this treatment, air bubbles will gradually work upwards, until at last there is a continuous column of mercury in the tube.

Before refilling a tube, it is advisable to heat both tube and mercury sufficiently to get rid of every trace of moisture. The mercury should not be allowed to come in contact with metals of any kind, as it has a great affinity for them, and is only removed from them with some difficulty.

The case of the barometer must now be well dusted out, and the glass cleaned. In replacing the tube, slope the case at a slight angle, to avoid the possibility of air getting into the tube.

Before screwing the case together the instrument should be set, using as standard a reliable barometer. The regulation is effected by pouring mercury into the bulb until the correct height on the scale is reached.

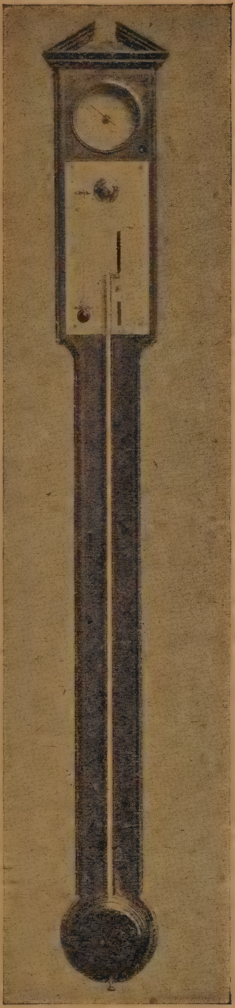
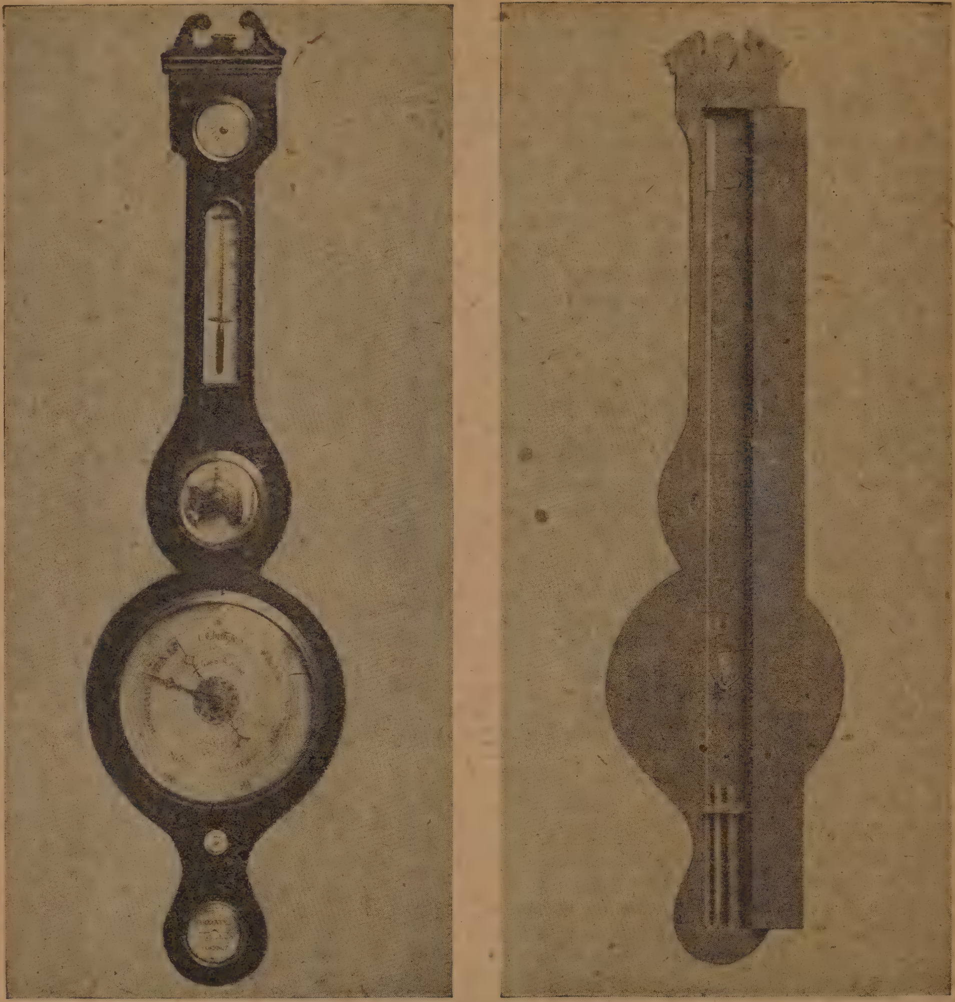


Fig. 4.—Cistern Barometer

Renovating the Cistern Barometer.—Of this type of barometer little can be said that has not already been said of the Fitzroy. The height of the mercury is adjusted by a screw (see Fig. 4) which presses on the leather diaphragm; the cistern is usually hidden from view by a wooden cap, sometimes screwed on from the back, and sometimes fastened by a couple of hooks. In the latter case it will slide up about ½ in., and then lift off.

The scale is engraved on either ivory or brass. Little can be done to improve discoloured ivory, but a badly tarnished brass scale can be restored to its original condition by re-plating and coating it with a transparent lacquer to prevent tarnishing.



Figs. 5 and 6.—Front and Back Views of Wheel Barometer

In ordering a new tube for this kind of barometer the dimensions should be carefully given, as the tubes vary considerably in different instruments. The best plan is to take a rubbing with a piece of heelball on a long strip of paper. This should show the entire length of the groove in which the tube fits, and also the size of the hole which takes the cistern.

Renovating Wheel Barometer.—To remove the tube of a wheel barometer (Fig. 5), open the door at the back (see Fig. 6), lift out the float and undo the wire loops which secure the tube. Clean the mercury, if necessary, in the manner already described. New tubes for these barometers are usually sent out with a pair of floats, and a short length of glass tube for the right-hand float to move in. See that the pulley to which the floats are attached works quite freely, and that the hand does not touch the glass. In fitting new thread to the floats allow one turn round the pulley for each in opposite directions, otherwise the pulley will be unable to move more than a short distance either way.

If the hygrometer—known in the trade as a "damp and dry"—the level, or the mirror, is missing, a complete new one, including the brass bezel, should be obtained. In ordering it is necessary to give the diameter of the holes, as most wholesale houses stock two or three sizes. If new bowed glasses are needed it is better to send the bezels and have the glasses cemented in.

Before replacing the tube, the case of the barometer should be overhauled and put in good order. If, as is frequently found, it has been covered with a treacle-like coat of dark varnish, this should be scraped off and the case french-polished. All the brass-work, including the dial, must, of course, be removed before this is done, and if any of the dials are badly tarnished they should be re-plated. The brass bezels, too, should be cleaned, and coated with a good yellow lacquer.

Renovating Aneroid Barometer.—The aneroid barometer (Fig. 7) is a delicate piece of mechanism, and should be handled very carefully, as it is easy to damage it through inexperience. The diagram (Fig. 8) makes clear the principle on which it works, and incidentally shows how a very small rise or fall of the top of the vacuum box is, by a system of long and short levers, converted into a considerable movement of the hand. It will be seen that, with a decrease of the atmospheric pressure, the top of the box A and the strong spring B rise simultaneously. A long rod C is screwed to the edge of the spring, and communicates its movement to the short arm of the pivoted lever D. To the end of the long arm of D is fastened a fine steel chain E, which passes partly round and is secured to the pulley F, whose axle carries the hand G. To keep the pulley in a state of tension the hair spring H is employed, and this carries the hand back when the chain moves in the direction of the arrow.

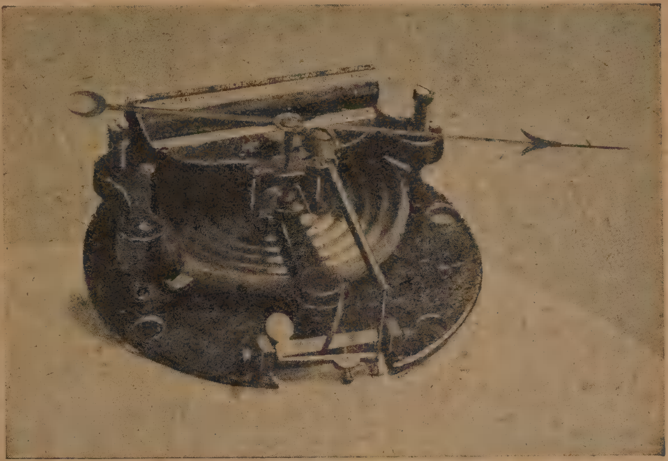


Fig. 7.—Mechanism of Aneroid Barometer

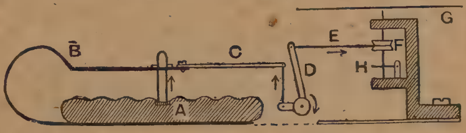


Fig. 8.—Section through Mechanism of Aneroid Barometer

To examine an aneroid barometer, first unscrew the bezel and glass. The hand, being pressed on tightly, can generally be removed with the thumb and finger, but sometimes something in the nature of a lever is required. Unscrew the dial and lift it off, and it will then be an easy matter to take the movement out of the case. The greatest enemy of the aneroid barometer is damp, so look first at the hairspring and chain, and see if they are rusty. Should the hairspring be broken near the stud, but otherwise in good condition, it may be taken up a little and re-pinned. Fitting these parts anew is a rather delicate piece of work, and it is best to entrust it to an experienced hand. See that all the working parts move freely, and that their action is not hindered by corrosion in the pivot holes. The holes may be cleaned by twirling a pointed piece of wood in them. The lever D should be adjusted so that it moves easily with the least possible amount of end-play. The screw in this lever regulates the comparative distance the hand travels in either direction, and must not be altered.

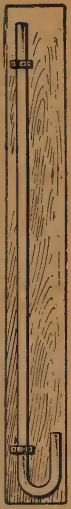


Fig 9.—Siphon Barometer

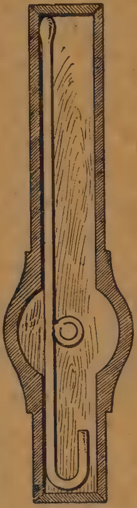


Fig. 10.—Wheel Barometer with Dial Removed

When replacing the instrument in the case see that it is screwed up tightly, and that it rests evenly upon the three loose pieces of wood or metal which keep it away from the back of the case.

After fixing the dial, the hand should be pressed on firmly at approximately its right position on the dial scale. For the final adjustment, for which a good barometer should be consulted, turn the screw which will be found at the back of the case a short distance either to right or left, as necessary.

BAROMETER MAKING

Making a Siphon Barometer.—This resembles the ordinary wheel barometer minus float, wheel, and the rest of the recording mechanism, as shown in Fig. 9. Its construction is very simple. First obtain a glass tube about 3 ft. long and $\frac{1}{3}$-in. bore. Close one end in a gas or spirit-lamp flame and blow it into a bulb (see a later chapter for instructions on glass blowing). When the bulb is blown, the end must be opened out; the exact size of the opening is not important as long as it is large enough to pour in the mercury. Next fuse a piece of spare glass tube to the other end; this is simply for convenience in working. Heat the end of the tube, and when fused draw it apart smartly. By this means the glass will suddenly taper off; break it at the narrowest point, and fuse it into a neat rounded end, perfectly air-tight. To test, direct the end against a gas flame and let someone blow vigorously down the tube; if there is a leakage it will at once show. A more delicate test is to dip the end in water and blow. Bubbles of air will be seen if the tube is not perfectly sealed. To do this with safety, the glass must be annealed and the water made lukewarm.

Next, the end which has the bulb must be bent as shown, with the long limb not less than 2 ft. 8 in. above the shorter limb.

A base must now be made of wood, to which the tube is secured with suitable cramps, as shown in Fig. 9. On the base a scale must be placed, 3 in. long, divided into $\frac{1}{10}$ in. A comparison should be made with another instrument, and the scale fixed accordingly.

Making a Wheel Barometer.—Although the barometer above described is quite sensitive, yet the fluctuations are so small that there is great difficulty in noticing any slight change, which is a great disadvantage when the instrument is used simply as a weather-glass. In the wheel barometer the fluctuations are enlarged, so that a slight change is easily noted.

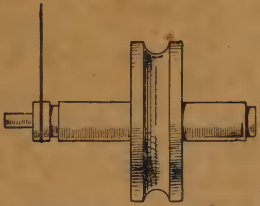


Fig. 11.—Wheel Carrying Index Finger

Fig. 10 shows the shape of the tube or siphon and the construction of the case. In this pattern the upper end of the tube is expanded into a bulb, which must not be perforated, but hermetically sealed, as this is to be a vacuum chamber. When the tube is filled, it is secured to the base of the case. There is also a spindle, on which a pulley, 2 in. in diameter, is fixed (in a manner to be described), with its diameter perpendicular to the short tube. A core of iron is required, of a size to enter the glass tube freely, and, say, ¾ in. long, with an eye at one end, to which is attached a gut cord, which passes over the pulley and is nearly counterbalanced by another weight. The difference must be just sufficient to enable the weight floating on the mercury in the tube to draw the other up when the mercury sinks in the short leg.

A dial-plate must next be prepared. This may be made of metal, and lacquered or silvered; of wood, carved, fretted, or painted in any artistic manner; or it may be of paper pasted to, say, tinplate, and ornamented in any way desired, or even left plain, simply with circles drawn and divisions marked. A finished dial may be purchased.

To make the body, proceed as follows: First make a full-size drawing. The body is 3 ft. long, 5 in. wide at ends, and 1 ft. wide in the centre. A piece of well seasoned mahogany, ½ in. thick, should be shaped as shown in Fig. 10. The sides and ends must be fastened to it, so as to make a shallow box, 2 in. deep. The circular centre will present no difficulty, as it can be made up in pieces. The inside need not be shaped, but left in the rough.

To make the spindle, procure 3 in. of ¼-in. square steel rod; heat it to a dull red, and let it cool slowly, to "draw its temper"—that is, to soften it. Bore a hole in a piece of mahogany 1 in. thick, and large enough to turn up a pulley 2 in. in diameter, into which drive the piece of softened steel. Centre the spindle and place it in the lathe, and turn it on the pulley, as shown in Fig. 11.

A bracket must next be made of stout brass, as shown in Fig. 12, A being a side view and B a front view. At the upper end of each limb of the bracket is a V-slot, to take the bearings of the spindle. The shoulders on the spindle will prevent its displacement. Two holes are to be drilled in each limb to receive the ends of a loop of wire which spans the slot, so as to prevent the spindle from being thrown from its position. The outside end of the spindle is squared down with a shoulder, on which is fixed the index finger, in the same way as the pointer of a clock is fixed. Having secured the spindle in its bracket, it must be screwed to the back, so that the spindle is in the centre of the circle.

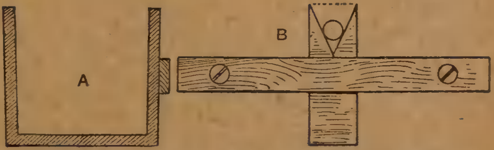


Fig. 12.—Bracket to Carry Barometer Wheel

Two blocks must be screwed to the back of the case, of such a height that when the tube is laid on them the centre of the bore of the tube shall be parallel with the groove on the spindle. The tube may now be secured with strips of copper or brass bent over it and screwed to the blocks.

The dial must now be fitted in its place, seeing that the spindle passes through the centre of the dial. The lid of the case, having a central opening 10 in. in diameter, must be neatly fixed with burnished-headed brass screws, the holes countersunk to receive them, care being taken that the position of the screws is carefully spaced out. A rebate must be made on the inside of the lid to receive a plate of glass, which can be secured in its place with small cleats glued on. The outer edge of the circular opening may be rounded or chamfered. An opening may be made in the bottom of the front, and a small spirit-level let in on the inside, and a thermometer may be let in in a similar manner at the top of the case.

When every part has been nicely adjusted, the front and dial can be removed, and the tube taken out for filling with mercury. One method of doing this has already been described, and another will receive attention later. When the tube is filled, the exact position of the points of the dial ("Fair," "Change," etc.) will have to be determined by reference to a good barometer. All that is necessary is to turn the dial round until the index finger points to the same conditions as are indicated by the standard.

Sometimes a small hole is drilled through the glass, and a small button is secured in the hole, with an index finger attached to it. The button is turned until the index is coincident with that on the dial; any change which may have taken place will now be shown.

In this kind of barometer a certain amount of friction has to be overcome, and also there is the risk of the weight becoming stuck. It is necessary sometimes to give the instrument a slight tap with the finger, as the jar will enable the weight to free itself from any impediment, and fall to the level of the mercury.

The mercury must be absolutely pure; it so readily enters into combination with other metals that there is always a danger of impurities being present; and it is evident that, in proportion as the mercury is mixed with other substances, its specific gravity will be altered, and, consequently, it will not register accurately; also, being less fluid, it will have a tendency to stick to the tube, and so fail in sensitiveness; in addition, the surface will become tarnished, so that minute differences in height will not be easily read.

To obtain absolutely pure mercury, it should be distilled; but the amateur can seldom do this conveniently. To test it he should twist a piece of writing-paper in the form of a grocer's sugar bag, leaving a pinhole at the point, and pour in the mercury, holding it over a vessel to receive it. As the mercury flows out, if it leaves no stain or dross on the paper, it may be considered pure; if, however, dross is left, it is not pure enough. A piece of good, clean, and stout chamois leather or a clean, strong linen handkerchief should be procured, and the mercury forced through it, as already described. The pores of the skin will allow the mercury to flow out, whilst the dross and impurities will be left behind.

A method of filling the tube with mercury has already been described; but it is not the only one available. It is better to use a straight tube as the subject of a first experiment; see that it is perfectly clean and dry. Turn it with the open end up, place a funnel with a fine point (the funnel may be of glass or one made of writing-paper) in the tube, and fill it with mercury, when it will run in a fine stream. The mercury will be stopped in its descent by a cushion of air that will get imprisoned; possibly a few gentle taps may serve to destroy the equilibrium and liberate the air. It may, however, be that this means will not be sufficient, and it will be necessary to apply heat. The heat must be carefully applied to the portion of the tube containing the air. This will be caused to expand, and so pass away as bubbles through the mercury.

When the tube is filled, the surface of the mercury will probably appear to be pitted with small air bubbles; the stream of mercury has carried down air attached to its surface. A film of air may also be seen to adhere to the surface of the glass; for air, like water and other fluids, has a tendency to stick to the surface of bodies. If any air bubbles are to be seen, heat must be applied, when they will liberate themselves, and will be forced upwards by the weight of the surrounding fluid.

When all the air has been expelled, place some mercury in the reservoir. With the finger cover the open end of the tube, invert it, and sink it whilst covered in the mercury contained in the reservoir. Now, when the finger is removed the mercury will descend in the tube and flow into the reservoir until the height of the column of mercury in the tube, measured from the surface of the mercury in the reservoir, will be equal to the weight of the atmosphere. When the atmosphere becomes heavier it will press still more on the surface of the mercury which, finding no resistance at the other end of the tube, will naturally ascend until the weight of the column of mercury is again balanced by the atmosphere. When the weight of the atmosphere is lessened, the mercury descends until balance is again restored.

If the open end of the tube is now closed with the finger or by any other means, and the tube is reversed, the mercury should fall to the bottom of the tube with a definite click, or knock against the end of the tube. If there is no definite sound there is a cushion of air in the end of the tube, which must be removed by the means already described, as a perfect vacuum, so far as air is concerned, must be procured in the tube.

When the tube is correctly adjusted, it can be fixed in the case, and the wheel, the hands, the balance weight, and the cord fitted.

Making a Glycerine Barometer.—The glycerine barometer or weather glass about to be described consists briefly of the following: A half-pint ale bottle with screw-top is about one-quarter filled with glycerine, in which a little magenta or other transparent colour has previously been dissolved, and a piece of glass tube is fitted (the joint being air-tight) through the screw-top of the bottle so as just to dip into the liquid. If a little air is forced into the bottle the glycerine will at once rise in the tube, and, provided the joint is air-tight, the height of the column will be found to vary continually according to the state of the air. The principle is not quite the same as in the mercurial barometer, although, of course, it is allied to it. The glycerine standing in the tube above the level of the glycerine in the bottle is supported by the extra density of the air inside the bottle. That air, slightly compressed, is forcing the glycerine up the tube against the opposing weight of the air outside acting upon the open-ended tube, and as the weight of the outside air varies with weather conditions, etc., the height of the column of glycerine standing in the tube will vary also. Contrary to the mercurial barometer, the heavier the atmosphere becomes, the lower will the glycerine sink in the tube. Any liquid would answer instead of glycerine merely to demonstrate the principle, but the glycerine has advantages in practice.

In constructing such a barometer, first make the box or case (see Figs. 13 to 15, p. 160), using wood about ⅜ in. thick. The inside measurements are 9½ in. high by 4½ in. square. Nail the two sides, 4½ in. by 9⅞ in., to the bottom; and, having shaped the back, 13¼ in. long, at the top as shown in Fig. 13, and halved and screwed to it a piece 3 ft. long by 1⅜ in. by ⅝ in. as shown in Fig. 14, it can be nailed to the sides and bottom. Next make the top of the box, Fig. 15, and temporarily fix it in position with 1¼ in. No. 8 japanned round-headed screws.

Next make the scale stick, and nail it to the back stick with a few long panel pins or shoemakers' rivets. The scale stick is ½ in. by 1¼ in., and 34 in. long, with the top end rounded off and the bottom cut square and flat, so as to fit nicely to the top of the box. The scale lines and figures should be made before the rod is fixed. The scale is divided into inches, with shorter lines for halves and quarters, heavy lines being made at 8½, 17, and 25½, thus dividing the scale into four equal parts. The lines are best made in waterproof indian-ink, using a ruling pen and square, and the figures and lettering done with a small camel-hair brush and well-ground, quick-drying dead-black paint; but before doing this work, the wood should be rubbed with a piece of cloth moistened with gold-size as a stopping.

The iron by which to hang the barometer is illustrated by Fig. 16, and should be screwed to the top of the back stick, as shown in Fig. 14.

The following materials will now be required for the barometer: A 40-in. length of straight tubing, 3/16 in. external diameter; an indiarubber stopper, ¾ in. external diameter with a 3/16-in. hole in the centre; 3 oz. of glycerine, and a small quantity of magenta crystals or a packet of aniline dye.

Grind down the top of the ale bottle to where the screwing begins, wash and dry it thoroughly, and about quarter fill it with the dyed glycerine. Then damp the rubber stopper and force it in so that it is flush with the top of the bottle. Clean the tube by pulling through several times a piece of string having a small tuft of cotton-wool fixed in the centre, and then round the ends on a grindstone. Moisten one end of the tube and insert it through the stopper into the bottle with a careful twisting motion, allowing at least ½ in. of the tube to dip into the liquid. Next varnish the top of the bottle and stopper to seal the two joints; almost any varnish will do, but if none is at hand dissolve a piece of sealing-wax in a small quantity of methylated spirit. When the varnish is quite hard blow down the tube into the bottle, which will cause the glycerine, when the mouth is removed, to rise in the tube.

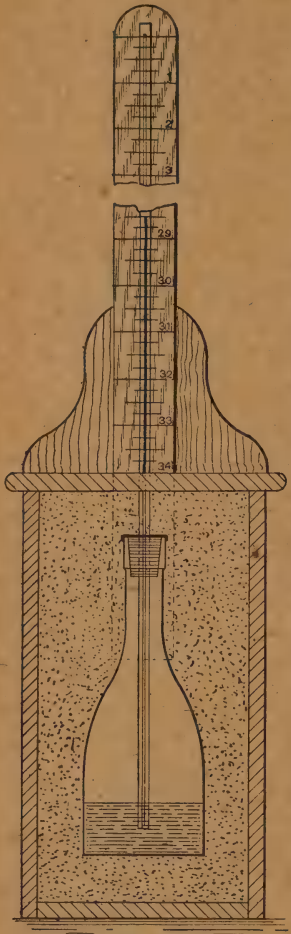


Fig. 13

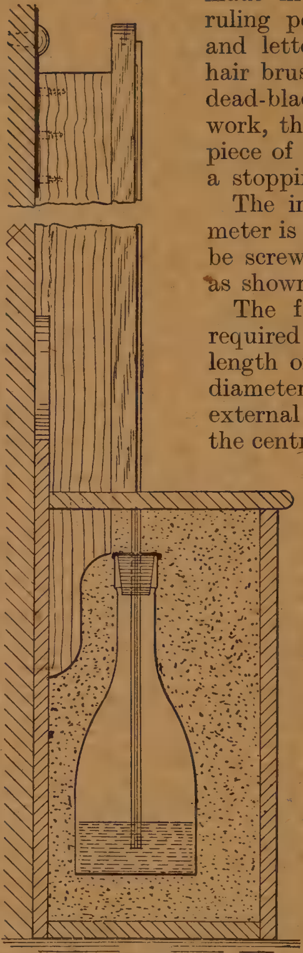


Fig. 14

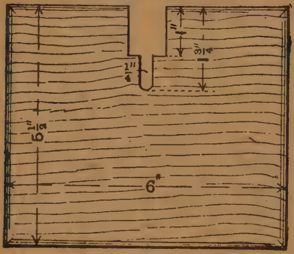


Fig. 15

Figs. 13 to 15.—Glycerine Barometer

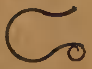


Fig. 17.—Index Clip

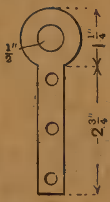


Fig. 16.—Hanging Plate

Notice should have been taken of an ordinary barometer, and if this reads very high the glycerine should have been made to stand fairly low. If the glycerine stands too high, any overflow can be watched for during stormy weather and then easily remedied; but if the glycerine is too low the instrument will never be satisfactory. Place a few drops of paraffin oil on the top of the glycerine column to protect it from dampness, and a small piece of cotton-wool, *quite loose*, in the top of the tube to keep out the dust.

Attach the front of the box with screws, and place inside it a 1-in. layer of a mixture of sawdust and pulverised charcoal. Stitch some flannel round the bottle to prevent sudden changes of temperature affecting the working, and insert the bottle in the box, pressing the mixture all round the bottle, so that the glass tube comes lightly in contact with the centre of the scale stick. The tube is fastened to the scale stick by means of two staples of thin copper wire pressed in with the fingers. The top of the box is fixed with japanned round-headed screws.

The index is made with a piece of tin ¼ in. wide and 2¼ in. long, bent to the shape of Fig. 17. This slips on the side of the scale stick and, being very easily shifted to any position, will be found very useful to indicate in which direction the glycerine column is moving. Three of these indexes should be made; one to set at night, one at morning, and a third for registering maximum of sudden rises.

A few hints on reading a glycerine barometer, which is much more sensitive than the wheel mercurial barometer, will be useful. A change of from 4 in. to 6 in. in the height of the column from day to day is by no means uncommon. Ordinarily, the glycerine will move up and down the centre part of the scale. When it rises above the 8½ mark, the weather will be stormy and wet; and whenever it falls and keeps steadily down at 25 or lower, fine, settled weather will prevail. Usually the glycerine will rise during the day and fall during the night, as warm air is lighter than cold, but these regular changes, being known, can be allowed for in the predictions.

Applying Window Transparencies

When properly applied, window transparencies should be perfectly even and flat. First clean the window thoroughly with water to which a little ammonia has been added, in order to remove all traces of grease; wash again with plain water, and wipe dry with a clean cloth. Next, if necessary, trim the sheet of gelatine-coated paper bearing the design to the exact size required, seeing that the edges are straight and the pattern effectively displayed. Then take a sheet of glass a little larger than the paper—if nothing better offers, one may be temporarily abstracted from a picture frame—and lay the paper flat upon it with the side that is to touch the window upward. In many cases both sides of the paper are adhesive, and either side may be used. Sponge gently all over with just tepid water, seeing that no part is missed; wet the window well with tepid water also. Without delay, raise the paper and apply to the window. Lay a piece of clean white blotting-paper over it, and, with a soft cloth, smooth it down carefully from centre to edges, rubbing well into contact, taking care that no air-bubbles are left between paper and glass and noting especially that the edges are firmly stuck. If these instructions are faithfully followed, the paper should dry free from all unevenness, and should simulate stained glass, whichever side it is seen from. The advice usually given is to wet the window alone, but this is a less satisfactory plan than the preceding, as small portions may become dry before the paper can be rubbed down, and the latter consequently peels or blisters.

Making and Erecting a Swing

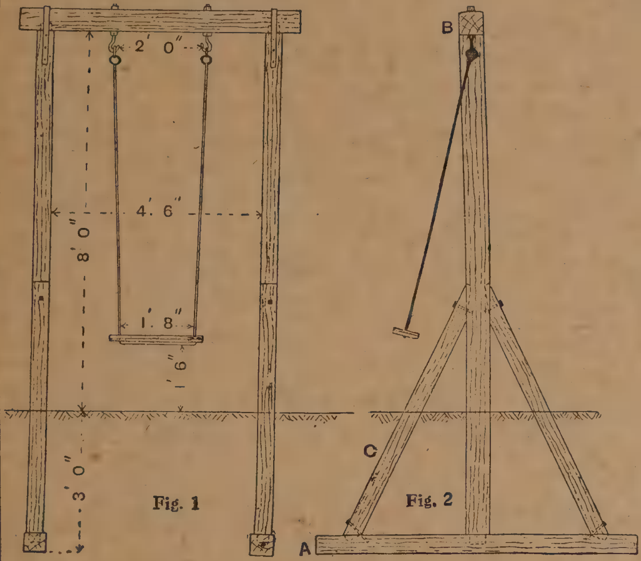
In constructing the garden swing shown by Figs. 1 and 2, the sizes of the timbers can be slightly modified to suit the material available, and, if desired, round timber can be used, except for the sills and struts. Oak is the best timber, but sound fir could be substituted, preferably creosoted, and it is best that the creosoting should be done after the various parts are cut to length and fitted. Otherwise the skin of creosoted fir is cut through, and the untouched fir exposed to decay. If constructed of fir and not creosoted, all the parts below, and for the first 6 in. above the ground line, should be thoroughly tarred, and the upper portions treated with four coats of paint.

The sills A are 7 ft. by 5 in. by 5 in., but, if obtainable, two second-hand railway sleepers may with advantage be substituted. (They could, if desired, be made of concrete reinforced with old iron, gas barrel, etc., with wood grounds let in while the concrete is soft for convenience in securing the struts.) The two posts are 11 ft. long by 6 in. by 4 in., stub-tenoned to the sills and to the head, which is 6 ft. long by 6 in. by 6 in. The upper surface of the head should be curved to throw off rain, as shown at B. The four struts, C, are each 6 ft. long by 4 in. by 4 in., with oblique tenons to the uprights and the sills, and further secured with strong coach screws and washers as shown. Two pieces of strap-iron, 2 in. by $\frac{1}{8}$ in., each 3 ft. long, are formed to shape, holed for six 2-in. stout screws and fixed to further secure the head (see Fig. 1).

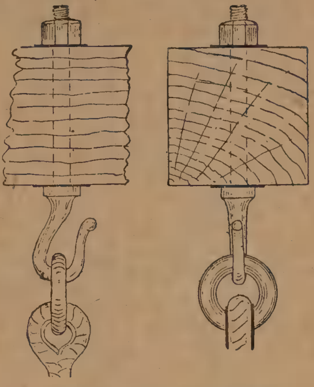
It will be found convenient, when all has been fitted, to leave the fixing of the head until the uprights are in position. Trenches as narrow as possible, say 1 ft. 6 in. wide, should be dug, the ground being taken out to the required depth only, and a level bottom made. When the uprights are in position and the head fixed, the excavation should be filled in, taking care to return no large stones, and thoroughly ramming as the filling proceeds.

The hooks in Fig. 1 are shown to a larger scale by Figs. 3 and 4. They are made from $\frac{3}{4}$-in. round iron bar, shouldered, screwed, and fitted with washers and nuts, and fixed through holes previously drilled 2 ft. apart. Corkscrew hooks, which are shown in Figs. 5 and 6, can be used if preferred, in which case they should be fixed so that in elevation (Fig. 1) they appear as in Fig. 5.

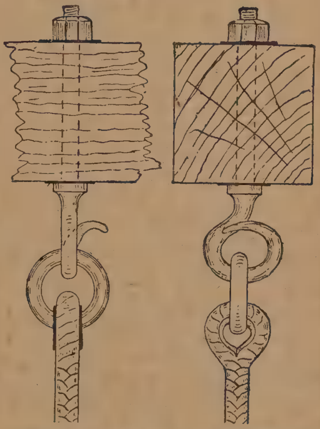
The manilla rope is 3 in. in circumference (nearly 1 in. thick), 15 ft. being required. It is spliced round the thimbles as shown in Figs. 3 to 6, through which thimbles the wrought-iron rings, of $\frac{3}{4}$-in. round iron and $2\frac{1}{4}$-in. internal diameter, have been previously fixed. It will be noticed that the rope must be passed through the holes in the seat before the second end is spliced. An alternative is to make large knots to the rope on the under-side of the seat, the rope to each end of the seat being a separate length. If splicing is beyond the worker's skill, the end of the rope must be secured by binding with strong new string for a distance of several inches.



Figs. 1 and 2.—Elevations (Part in Section) of Garden Swing



Figs. 3 and 4.—Swing Hooks, etc.



Figs. 5 and 6.—Corkscrew Hooks

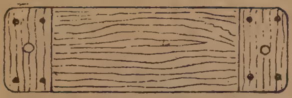


Fig. 7.—Underneath Plan of Seat

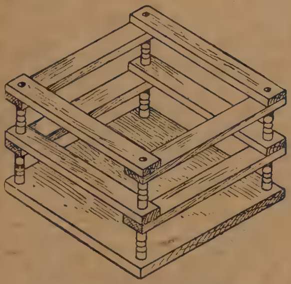


Fig. 8.—Baby's Swing

The seat, an underneath view of which is shown by Fig. 7, whether of oak or deal, should be planed and varnished. It is 2 ft. by 7 in. by $\frac{3}{4}$ in., strengthened at each end with a piece of 4-in. by $\frac{1}{2}$-in. stuff, fixed from the under-side with four 1-in. stout screws with countersunk heads as shown (Fig. 7). The centre of the rope holes should be 1 ft. 8 in. apart. The seat should not be more than 1 ft. 6 in. from the ground. All sharp arrises should be taken off, and the corners of the seat rounded. All ironwork, unless galvanised, should be either japanned or painted.

A BABY SWING

A baby's swing is easily put together if Fig. 8 is followed. The seat is made from beech, say 1 in. thick and 15 in. by 15 in., with a $\frac{1}{2}$-in. hole through each corner. Four ropes are passed through these holes, and stopped by knots underneath. The other ends are spliced or tied, two to each upper rope. Eight wooden spindles, bored from end to end with $\frac{1}{2}$-in. holes to allow the lower ropes to slide through, are passed on as shown. Eight cross-bars, bored near the ends with $\frac{1}{2}$-in. holes, and strung on—four between the two sets of spindles and four above them—will complete the swing. The cross-bars and spindles must be of beech, oak, or other hardwood, or they will be apt to split and lead to accident. The cross-bars can be 2 in. by $\frac{3}{4}$ in. by 15 in., and the spindles 1 in. in diameter and 3 in. long. If the seat-guard is not considered deep enough, add four more spindles and four more cross-bars. Knots can be made above the seat-guard to keep the cross-pieces and spindles in place, if desired; but that is not usual, as the child's weight will be found sufficient to prevent slipping. The four lower ropes should join the two upper ones about 12 in. above the top of the seat-guard.

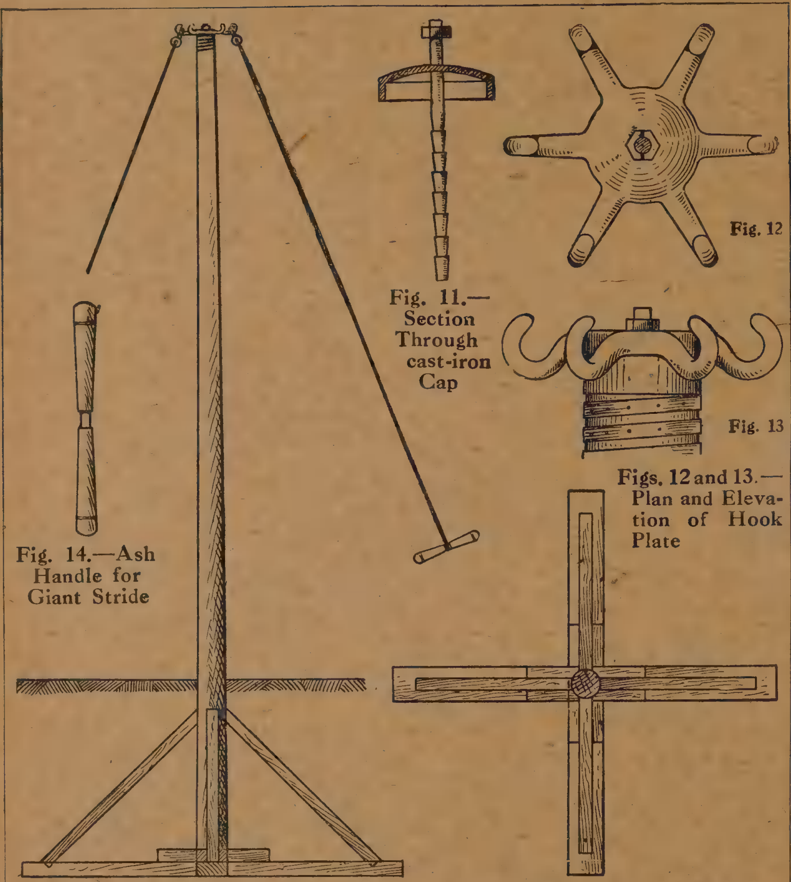


Fig. 11.—Section Through cast-iron Cap

Fig. 12

Fig. 13

Figs. 12 and 13.—Plan and Elevation of Hook Plate

Fig. 14.—Ash Handle for Giant Stride

Fig. 9.—Elevation of Giant Stride

Fig 10.—Plan of Giant Stride

If the swing is not to be suspended from a frame of the kind already described, but is for indoor use, two places are found in the ceiling so that when hooks are screwed in they will enter the wood of the joists, and not merely hold by the plaster or the lathing. By driving a fine awl into the ceiling, the position of the joists can be found without much damage. It is frequently a convenience to suspend the swing from hooks screwed into the door-frame. The ropes must be hung by metal eyelets held in spliced loops, for which see Figs. 5 and 6.

GIANT STRIDE

In constructing the giant stride shown in elevation by Fig. 9 and plan by Fig. 10, the remarks already made with regard to the advisability of using oak or creosoted fir below the ground level, or otherwise thoroughly tarring these parts, largely apply.

The base is constructed of two pieces 4 in. by 9 in. by 9 ft. 9 in. long, halved together at the crossing. Four struts out of 4-in. by 4-in. stuff and 5 ft. 9 in. long, fixed with oblique tenons and coach screws to the spar and to the 4-in. by 9-in. pieces, are required. Four short pieces of 4-in. by 9-in. stuff, each about 1 ft. long, are also required. These are fixed in position as shown in Fig. 9, the ends being carefully fitted round the foot of the spar, securing it more firmly than if the small stub tenon only were used. A yellow Norway spar, 21 ft. long, 7 in. in diameter at the top and about 9 in. in diameter at the foot, will be required. The bottom should be sawn off perfectly true and stub-tenoned as just mentioned, and the portion of the spar under the ground thoroughly tarred. The exposed part of the spar is usually scraped and varnished, but four coats of paint on the cleaned or wrought surface is an alternative.

A cap of cast-iron, shown in section at Fig. 11, is required for the top. It should be carefully cast of $\frac{1}{2}$-in. metal, with a hole $1\frac{1}{4}$ in. in diameter centrally in the top, and with a few holes for countersunk screws for fixing in position when the upper end of the spar has been cut away to fit it. The cap should be bedded in white-lead.

The hook-plate is of wrought-iron, as shown in Figs. 12 and 13. The centre part of the plate is $1\frac{1}{4}$ in. thick, and the six hooks are forged to 1 in. in diameter and to the shape shown. The hole, $1\frac{1}{4}$ in. in diameter, must be drilled central. The centre-pin is of wrought-iron, $1\frac{1}{4}$ in. in diameter and 1 ft. 3 in. long, and is slightly tapering and slightly jagged, as Fig. 11. A tapered hole, commencing with a $1\frac{1}{4}$-in. bit and finishing with a 1-in. bit, should be bored vertically into the end of the spar, and into this hole the pin is driven, a tight fit.

To prevent splitting, either in fixing or in use, the spar is bound with about 10 ft. of 1-in. galvanised hoop-iron, fixed with $1\frac{1}{2}$-in. clout nails at about 2-in. intervals. The upper end of the pin is screwed for a hexagon nut, which is prevented from working loose by a small $\frac{1}{8}$-in. pin fitted through a hole above it, as shown by Fig. 12. All the ironwork should be well painted, and the centre pin and plate thoroughly oiled when erection is complete.

For the six ropes, 15 ft. of manilla, 3 in. in circumference, is required for each. It should be spliced to thimbles and rings as shown in Figs. 3 to 6, for the top; and spliced round turned ash handles 1 ft. 3 in. long and $1\frac{1}{2}$ in. in diameter, turned up as shown in Fig. 14. Special attention is directed to the groove for the rope, which, though slight, will be found sufficient. If the splicing is done very tightly to a dry rope, the handle can then be hammered in, and exposure to the weather will draw the rope quite tight. Thus, by drying the rope, a new handle can be inserted when renewal is necessary, without going to the trouble of re-splicing.

Celluloid and Film Cements

Scraps of colourless celluloid dissolved in amyl acetate make a good cement for celluloid. Often two celluloid surfaces may be strongly joined merely by wetting them with the above-mentioned solvent and pressing them together. A mixture of equal parts of amyl acetate and acetone is often used as a solvent for celluloid in making cinematograph-film cement. "Non-flam" film, which resembles celluloid in appearance, is best cemented with a solution of pieces of the "non-flam" in chloroform, a substance that should be used with great care.

Window and Green-house Glazing

Tools.—The tools required for re-glazing windows are few, and the skill necessary is not great. When failure in re-glazing does occur, usually it is due to the faulty cutting out of the old putty; the glass presses here and there on the old lumps, thus setting up an irregular strain, ultimately cracking the glass. The right tool for cutting out the hard putty is a hack knife, which consists of a steel blade with a piece of leather on each side to form a handle, as shown in Fig. 54, p. 35, of this volume, and by Figs. 1 and 2 on this page. The blade is thickened at the back as in Fig. 3, and the knife is used by holding the sharp edge against the putty, and tapping the thick back with the hammer.

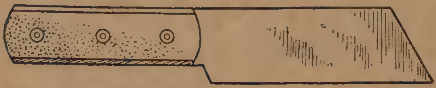


Fig. 1.—Hack Knife

Fig. 2.—Section Through Handle of Hack Knife

Fig. 3.—Section Through Blade of Hack Knife

The only other special tool required is a glazing knife resembling Fig. 58 (p. 35), and shown by Fig. 4 on this page; this is stiffer in the blade than the ordinary putty knife, but otherwise is identical with it.

Cheap as both of these tools are, they can both be easily improvised, the hack knife out of an old file, and the putty knife from a broken table knife.

The Glass.—Common sheet glass sold is of foreign make, but the best is British, which is obtainable in three grades, known respectively as "best" (suitable for high-class work), "seconds" (the quality in general use for all-round work), and "thirds" (suitable for cottage property, etc.). Except for greenhouses, conservatories, frames, and other horticultural work, any quality below "thirds" would hardly be satisfactory. Foreign sheet glass is extensively used for horticultural work. Sheet glass is described by the weight in ounces per square foot, and the general thicknesses are 15 oz., 21 oz., 26 oz., and 32 oz.; but it can be had thicker if desired. Except for inferior work, it is probably more economical to use nothing lighter than 21-oz. glass (about $\frac{1}{10}$ in. thick), for with thinner glass the risk of breakage is very great; 26-oz. glass is better when the squares are large, or for glazing door panels or other framings subjected to vibration; in the

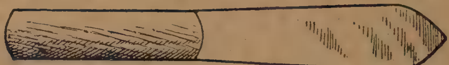


Fig. 4.—Glazing Knife

latter case, the glass should, in best work, be bedded in washleather. For extremely large squares, 32-oz. glass should be used when expense prohibits the use of plate glass.

Sheet glass may be said to intercept half as much light again as British polished plate, the kind of glass that should be used for shop-fronts, etc.

In ordering glass, it should be remembered that the extreme length made and the extreme width made are not combined in one sheet. For 15-oz. sheet glass the extreme length is about 5 ft., while the width is 3 ft. 4 in., the extreme area being 16 ft. For 21-oz., 26-oz., and 32-oz. glass the extreme dimensions (as well as the area) are larger.

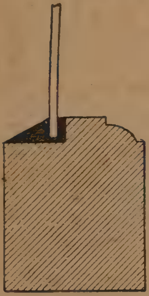


Fig. 5.—Window Glass Surrounded by Putty

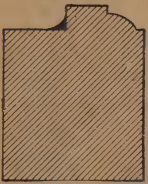


Fig. 6.—Old Putty Left in Rebate of Frame

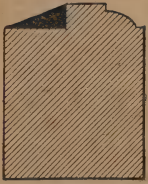


Fig. 7.—Rebate of Frame Filled with New Putty

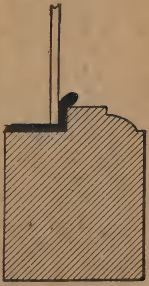


Fig 8.—Back Putty Squeezed Out by Glass

Inserting the Pane of Glass.—In perfect putty glazing, when the glass is in place it is surrounded by putty, as in Fig. 5, and in renewing a pane this putty must be wholly removed, not left in the corner of the rebate as in Fig. 6. But avoid cutting into the wood, especially in the case of the "bars" or narrow strips dividing the glass.

After cutting away the old putty with a hack knife and hammer, the rebate must be filled with new soft putty, as in Fig. 7. The glass is then pressed in evenly, rubbing it near the edges with the fingers of each hand at the same time, until it squeezes the putty out at the back, leaving only a thin layer between itself and the wood, as in Fig. 8.

The glass should be at least $\frac{1}{8}$ in. smaller each way then the actual opening, so that it rests on putty everywhere, and has putty on all sides. If the wood touches it, there is a danger of breakage, not only when putting it in, but afterwards if the window is opened or closed sharply.

The front putty can now be applied (see Fig. 5), it being usually run on with the fingers. Then, taking one side at a time, a clean bevel is formed by drawing the knife along, resting it on the bar and on the glass, keeping the bevel somewhat abrupt, so that it is not seen through the glass from the inside. Do not attempt to scrape off the fine strips of putty left on the glass, but brush them off with a dusting-brush; otherwise the bevel may be spoilt in the scraping. When this is finished, but not before, run the knife round against the glass and wood at the back, thus cutting away the surplus putty which has squeezed out in the bedding-in of the glass; and stop up any little places that need attention.

In sliding sashes, the top part of the glass in the bottom sash may fit into a groove in what is called the meeting rail A (Fig. 9), and the putty must be cleared from this groove just as thoroughly as from the rebates.

Should the pane be of fairly large size, it requires something besides the soft putty to hold it in place. Small brads are often used; but small triangular pieces of zinc, as in Fig. 10, called "glazier's points," are safer and better, as they can be pressed in close to the glass easily, and covered by the front putty. About two at each edge of an average-size pane are sufficient.

Removing Very Hard Putty.—Very hard putty can be softened by holding a red-hot iron against it, taking care not to burn the woodwork or crack the next square. A suitable tool is an old poker, with the square part bent at a right angle to the handle or stem. Make it red-hot at the junction of the square and round parts before attempting to bend it; it can easily be bent back again after use.

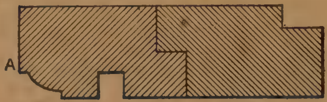


Fig. 9.—Section of Sliding Sash showing Groove in Meeting Rail

Removing Sash for Glazing.—Should it be found awkward to get at a square of glass by sitting on the window-sill, the sash may be taken out. To do this, take out one side sash bead, get hold of the sash cord, and pull the weight right up to the sash pulley; then carefully drive a clout-headed nail through the cord into the pulley stile just below the pulley, to keep the weight up; treat the other side in the same manner, and then undo the cords from the sash and take it out.

Glass Cutting: Tools and Methods.—The amateur can always buy his glass cut to size, but glass-cutting tools are very useful. A good diamond may cost well over a sovereign, though a serviceable one may often be obtained for less. It needs to be very carefully used. A variety of wheel glass-cutters are obtainable. They are not so generally useful as the diamond; but they are much less expensive, and, if used properly, will answer most ordinary requirements. The wheel consists of glass-hard steel well sharpened; and glass scratched with it is easily broken. The necessary "knack" in using it can be found only by experience. For re-sharpening a wheel, remove it from the holder by punching out the rivet; then, through its hole, press a fine-tapered awl B (Fig. 11). Glue a piece of medium-grade emery-cloth C to a block of wood D, secure the tang end of the awl in the chuck of an Archimedean or similar drill-stock E, and place the wheel A over the emery. Work the drill until the point of the awl pierces the wood, bringing the cutter wheel into close contact with the emery; then, lubricating the wheel with turps, continue working the drill. Afterwards reverse the wheel and repeat the operation.

In cutting glass, hold the diamond or the wheel firmly, but without heavy pressure, and draw it *once only* over the imaginary line where the cut is to be made (see Fig. 12). Then slide the glass along until the scratch coincides with the edge of the bench or table, and by means of downward pressure on the overhanging part, break the glass at the scratched line. The breaking along the line can be greatly facilitated by gently tapping the glass beneath the line with some hard substance. Heavy pressure of the diamond or, more especially, of the wheel glass-cutter is liable to crack the glass, not, unfortunately, in the direction required, but at an angle to it; and this accident is all the more liable to happen if the glass is not well bedded on a firm but not necessarily hard surface. A baize-covered table-top is an excellent support for the purpose.

Fig. 10. — Triangular Scrap of Zinc for use as Brad

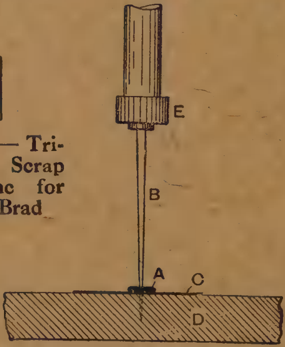


Fig. 11.—Sharpening Wheel Glass-cutter

Glass can be cracked in a straight line by the following method, but no glazier is recommended to try it, the risk of non-intentional breakage being too great: First file a small notch at the edge of the glass where the cut is to start, and again at the edge where it is to finish. Have a piece of iron wire fixed in a wooden handle; heat the wire to red heat, and run it slowly along the surface of the glass in the direction in which the glass is to be cut, being careful to begin and end exactly at the filed notches. As the wire is moved along, the glass will be observed cracking in a clean line after it. It is better not to point the wire, as it does not conduct the heat so well as when left plainly cut across.

Greenhouse Glazing. — In glazing a greenhouse it is useful to dispense with a front putty. Well paint the rebate with white-lead mixed with linseed oil, and then run a layer of ordinary putty with which a little red-lead has been mixed, this assisting the putty to dry more quickly. The glass is made a tighter fit than in window glazing, and is well rubbed down into the putty; force in sprigs or the tiny pieces of zinc already illustrated along the edges to hold the glass, after which give the edges and rebate three coats of good oil paint. When front putties are used, the work is done exactly as already described for window glazing; but it is well first to apply a little paint all round the rebate.

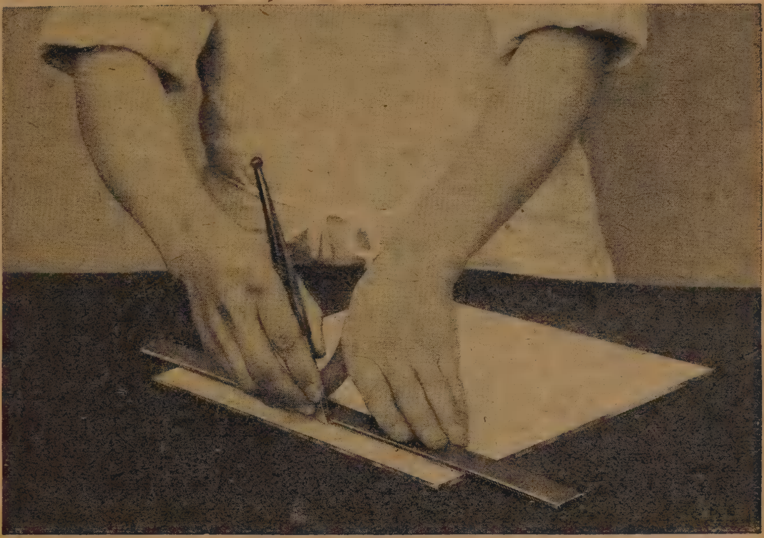


Fig. 12.—Method of Holding Diamond in Cutting Glass

In glazing the slopes of greenhouses, garden lights, etc., where there are no horizontal bars, or very few of them, the lowest pane is inserted first, and the next one overlaps it so as to throw off the rainwater.

The repair of old greenhouse roofs is frequently a risky undertaking, as they will not always bear a man's weight. Often, though, the roof is constructed of sliding bays, which can be slid down. Failing this, it is well to nail a strong crosspiece on a short ladder, and suspend the ladder from the greenhouse ridge, some part of the weight resting, of course, on the sloping roof. The repairer allows most of his weight to come on the ladder, which distributes the load; but even then extreme caution should be exercised. Greenhouses are peculiarly susceptible to the effects of rot, and the writer has known many cases in which sound-looking horticultural woodwork has proved quite rotten.

The objection to top putties is that they tend to come away from the glass and wood, the water then getting to the woodwork and causing rot. Horticultural roof work should be primed and painted before glazing; some people also paint the edges of the glass. The putties should be painted as soon as the glazing is completed, and the paint allowed to extend $\frac{1}{4}$ in. beyond the line of the putty, the work receiving at least two or three coats of paint.

When the top putties are omitted, breakages are more easily repaired, less putty is used, and the rebates in the bars —for new work—need not be so deep.

Fitting up Shelves and Rails

Erecting a Shelf.—One of the amateur mechanic's commonest jobs is to put up a shelf in a recess. The ordinary way of doing this is to fix bearers or cleats, of the shape shown by Fig. 1, on each wall, to support the shelf under each end. The wall must be plugged in two places for each cleat, for nailing or screwing at the points shown.

It is possible to avoid plugging the walls. The cleats then are made as shown by Fig. 2, being grooved to fit the ends of the shelf, and are fixed to the wall with three nails. It is best to find the joints between the bricks and use nails about 3 in. long. The shelf is made to slide into the grooves and should fit tight (see Fig. 3). Or the cleats could be of the shape shown by Fig. 4, being rebated instead of grooved. It is sometimes necessary to put a cleat at the back edge of the shelf, when, for neatness, the corners may be mitred.

Another useful shelf is shown by Fig. 5; when there is a return wall at one end only to fix a horizontal cleat, the other end has the cleat fixed vertically, the shelf being nailed on the top end, and supported by an iron bracket as in Fig. 6.

When it is desired to fix long shelves one above the other, the work is done as shown by Fig. 7, which shows the points for plugging and nailing the cleats. The vertical end piece need not be so wide as the shelves and may fit against the ceiling, the ends of the shelves being trenched into it and nailed; also it is nailed to the ends of the long cleat pieces. It further requires securing with a couple of holdfasts as shown by Fig. 8, and the shelves supported by iron brackets screwed on the vertical cleats. These shelves are often used for plates stood up on edge against the wall, the front part of the shelf being used for other things. When this is so, a bead is required to keep the plates up; it should be as small as possible (about $\frac{1}{4}$ in. in section) and about 1 in. from the wall (see Fig. 9), so as not to take too much off the width of the shelf. The beads may be fixed with fine nails, and may be 6 in. shorter than the shelves, to allow 3 in. space at each end for ease in dusting or washing the shelves. This applies to all plate shelves.

A Plate Shelf.—A simply constructed plate shelf of the ordinary type is shown by Fig. 10. The size and number of shelves may be varied as occasion requires, an average being about 4 ft. 6 in. square. A suitable wood is "spruce shelving," in boards about 6 in. wide by 1 in. thick, or it may be selected flooring boards. The ends of the shelves are trenched in, as in Fig. 11, being stopped about $\frac{1}{2}$ in. from the front edge. They are glued and nailed as Fig. 12 shows, using $2\frac{1}{2}$-in. oval wire nails; the centre one is driven straight and afterwards the others are "skewed."

When the shelves are all fixed, a frieze about $2\frac{1}{2}$ in. wide is nailed in flush with

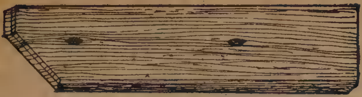


Fig. 1

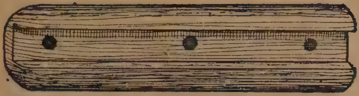


Fig. 2

Figs. 1 and 2.—Cleats or Bearers for Shelves

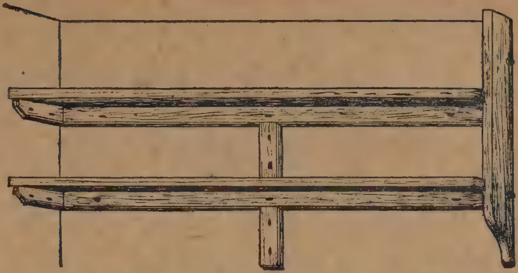


Fig. 7.—Shelves Fitted One Above Another

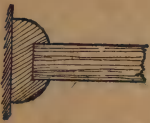


Fig. 3

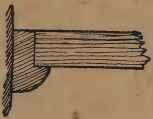


Fig. 4

Figs. 3 and 4.—Sections of Grooved and Rebated Cleats respectively

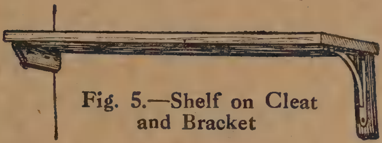


Fig. 5.—Shelf on Cleat and Bracket

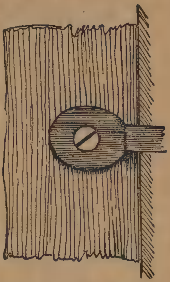


Fig. 8.—Fixing Shelving with Holdfast

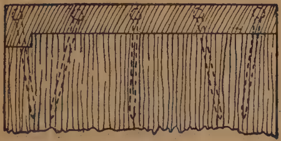


Fig. 12.—Skew-nailing a Shelf

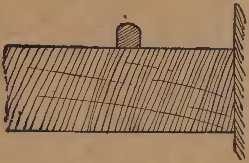
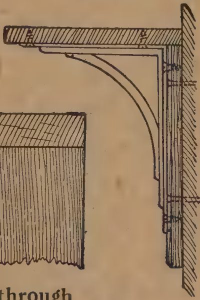


Fig. 9.—Section Showing Beading on Plate Shelf



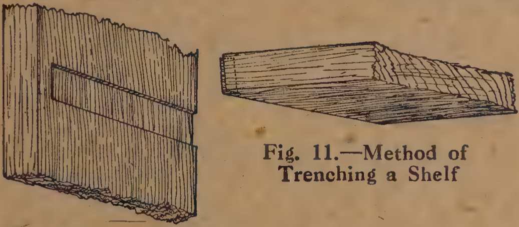


Fig. 11.—Method of Trenching a Shelf

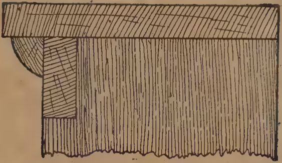


Fig. 13.—Section through Top Part of Plate Shelf

Fig. 6.—Section through Shelf and Bracket

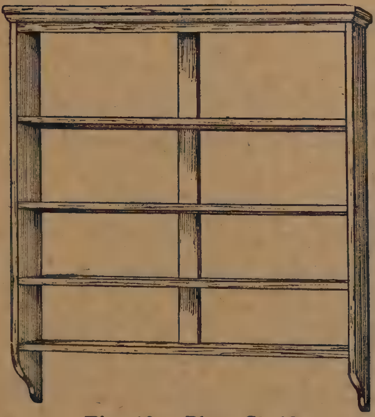


Fig. 10.—Plate Shelf

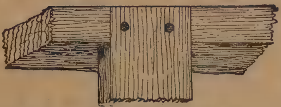


Fig. 14.—Detail at Centre Back Edge of Plate Shelf

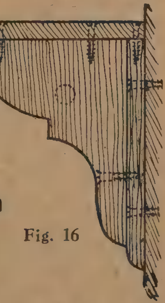


Fig. 16

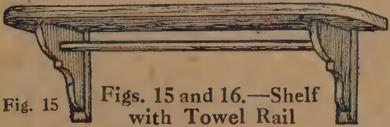


Fig. 15

Figs. 15 and 16.—Shelf with Towel Rail

the top corners, and the top nailed on to overhang 1¼ in. at the front and ends; then the rounded piece may be fixed under (see Fig. 13); or a piece of moulding would do. To give extra strength a batten is fixed up the back, being let into the edges of the top and shelves, as in Fig. 14.

To fix the plate shelf, two holdfasts may be driven into the wall to come under the top about 6 in. from each corner, and two more under the lower shelf.

A Bathroom Shelf.—A style of shelf that will be found useful in bathrooms, etc., is shown by Fig. 15; the construction and fixing of it are shown by Fig. 16. The towel-rail is fixed by letting one end into the bracket, the other end being secured with a screw.

A Drop-shelf or Wall Table.—This is shown by Fig. 17. It is 3 ft. long by 1 ft. 6 in. wide. The cleats are 1 ft. 5 in. long by 2 in. wide, and may be finished as shown, or they may be long enough to reach the skirting board. They are fixed to be 2 in. in from the ends of the shelf, the wall being plugged for securing the cleats with screws, at points 3½ in. and 10½ in. from the top end. The shelf is in two pieces: one 1 ft. 4 in. wide, and the other a strip 2 in. wide. The wall is plugged for fixing the strip with screws 6½ in. from each end, and it is also nailed to the top ends of the cleats. The brackets are made each with two pieces 1 ft. 1 in. and 1 ft. 3 in. by 2 in. by 1 in., mortise-and-tenon jointed together at right angles, and straightened with a strut piece. This latter is notched in at the points and fixed with glue and screws, then bored with a ⅜-in. twist bit and wood dowels are glued in, as shown in Fig. 18; which figure also shows the position of the hinges, covering up the screws in the cleats and shelf strip (see also Fig. 19), which shows the finished shelf let down. In some cases, to keep the shelf straight it is necessary to put battens across on the under-side, as in Fig. 20. Smaller shelves, not having to bear much weight, need only have one bracket, under the centre.

Corner Shelf. — Corner shelves have a very neat appearance, and are frequently finished in white enamel. The cleats in the case of the shelf shown by Fig. 21 are fixed as shown in Fig. 22, the sectional shape being shown in Fig. 23, and the front ends are rounded off to a point as in Fig. 24.

Hanging Rails for Clothes, etc.—These are usually from 3 in. to 4½ in. wide, with a simple mould worked on the edges; or they may be rounded or just chamfered. In fixing them, the positions of the hooks should first be marked. Two pluggings of the wall are about right for rails up to 3 ft. in length, and the plugging should occur directly behind the two end hooks, so that the fixing nails or screws may be covered up as in Fig. 25. Screws are better than nails, because they can easily be removed when required, and it will be found an advantage to do so when the walls have to be papered or painted. It will be easier still to remove them if they are fitted with metal earplates of the kind shown by Fig 26, to fit over brass-headed nails driven into the wood plugs as in Fig. 27. With these it is only a matter of hanging the rail up or lifting it down.

These rails are very useful fitted with small-size hooks, and what are called "cup hooks," for hanging up house-cleaning implements, as in Fig. 28. Brooms, etc., are apt to be a nuisance if left lying about or stood up against walls; they are better every way for being hung up, this being made possible by putting a screw-eye at the end of the handle, or a loop of string.

Towel Rails.—These are very essential fixtures in the home. One that is most readily fixed is shown by Fig. 29. It consists of a 2-ft. length of ½-in. brass-cased tube, supported in a pair of metal brackets, screwed on to the wood rail; but when there is woodwork to which the brackets can be fixed, the wood rail is not necessary. The brackets are as in Fig. 30, being, with the brass rod, common stock articles obtainable at most iron-mongers'.

In many cases, however, the towel rails are preferred in wood. One advantage of these is that the rails being thicker

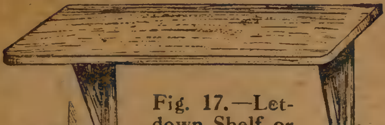


Fig. 17.—Let-down Shelf or Wall Table

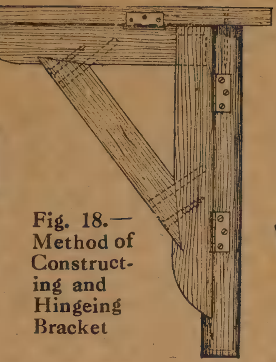


Fig. 18.—Method of Constructing and Hingeing Bracket

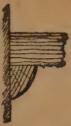


Fig. 23.— Part Section of Corner Shelf

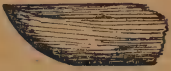


Fig. 24.—Corner Shelf Support

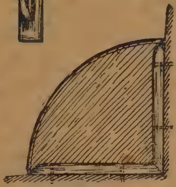


Fig. 22,

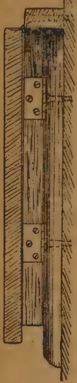


Fig. 19.—End Elevation of Wall Table, Not in Use

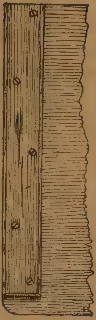


Fig. 20.—End of Let-down Shelf

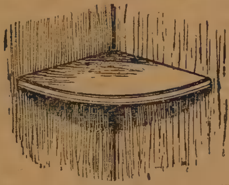


Fig. 21.

Figs. 21 and 22.—Corner Shelf

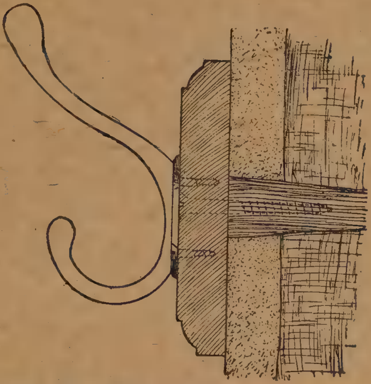


Fig. 25.—Section through Hanging Rail

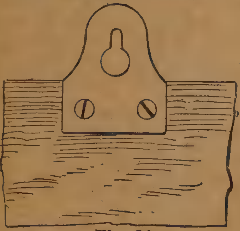


Fig. 26

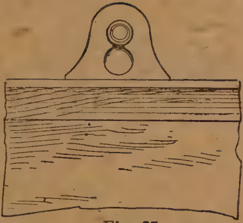


Fig. 27

Figs. 26 and 27.—Ear-plate on Rail

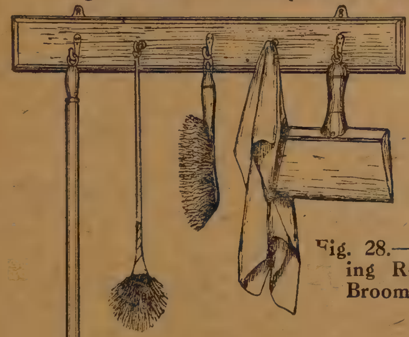


Fig. 28.—Hanging Rail for Brooms, etc.

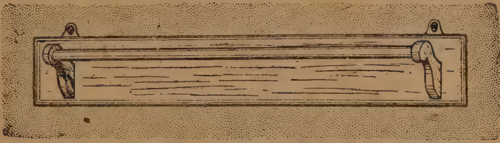


Fig. 31.—Towel Rail with Wooden Rod

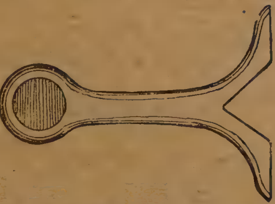


Fig. 30.—Towel-rail Bracket

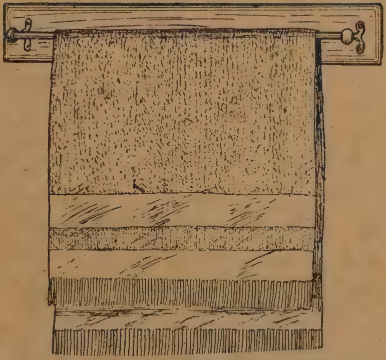


Fig. 29.—Towel Rail with Brass Rod

more air space is allowed between the folds of the towel, causing it to dry more quickly. When the rails are white-enamelled they can be easily kept clean, and always have a nice appearance.

A towel rail that will be found especially useful in bathrooms is shown by Fig. 31. Up to 3 ft. in length, the rounded rail may be of 1 in. diameter, ½ in. at each end being reduced to a ½-in. diameter pin to fit a hole in the scroll end of the brackets (see Fig. 32), which may be cut from ¾-in. hardwood or 1-in. deal. The wood rail to which they are screwed may be of ¾-in. deal. Instead of reducing the ends of the round rail, it is sometimes readier to form the pins by letting in a bit of dowel as in Fig. 33. And at times the brackets are fixed direct on to the wall with long screws driven through from the front, especially so when the brackets are of the form shown by Fig. 34, and the wall happens to be a lath-and-plaster partition (see Fig. 35); or when there is woodwork to fix to. In the case of a brick wall, four pluggings are necessary. The screw-heads should be sunk, and the holes filled up with white-lead putty. This shape of bracket is stronger and is shown as for a 1½-in. diameter rail, to take the heaviest bath towel.

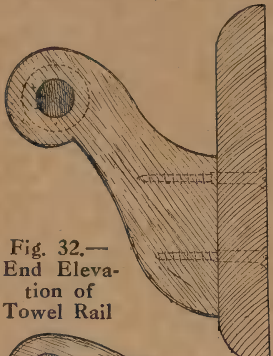


Fig. 32.—End Elevation of Towel Rail

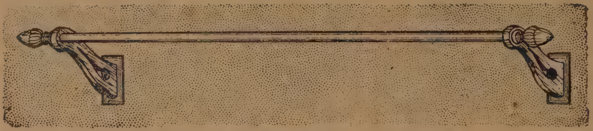


Fig. 36.—Brass Mantel Rail

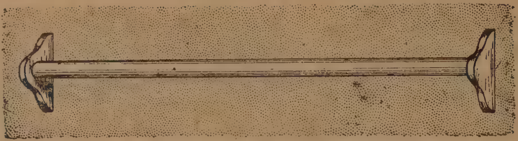


Fig. 34.—Towel Rail without Back-board

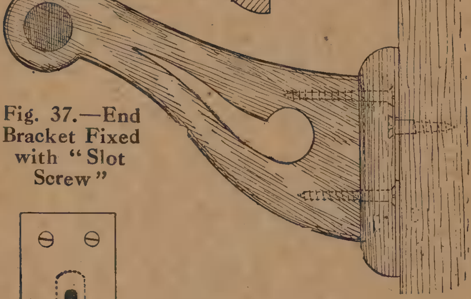


Fig. 37.—End Bracket Fixed with "Slot Screw"

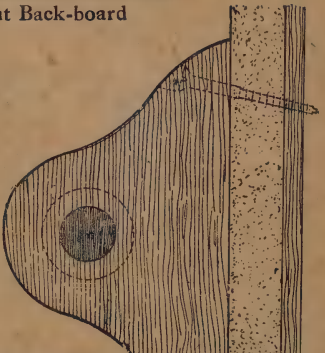


Fig. 35.—End Bracket Screwed to Lath-and-Plaster Partition

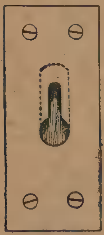


Fig. 38.—"Slot Screw" Plate

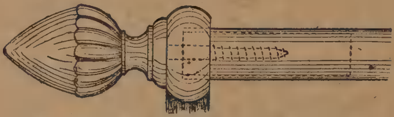


Fig. 39.—Brass Rail and Terminal

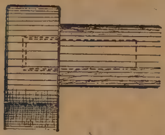


Fig. 33.—End of Rail Fitted to Bracket with Wood Dowel

Mantel Rails.—Brass rails for kitchen fireplaces are to be purchased with brackets complete; but these are usually rather heavy, both in appearance and cost. A handy rail that can be fitted up at home at small cost is shown by Fig. 36. It is of $\frac{3}{4}$-in. brass-cased iron tube plugged with wood at each end, and fitted with a pair of ornamental brass terminals. These latter would do in wood, preferably oak, the same as the brackets, which are cut from $\frac{5}{8}$-in. thick material. They are fixed by means of a "slot-screw," so as to be easily removed; and they hold the rail about 5 in. out from the wall, as shown by Fig. 37, which also shows how the shaped bracket piece is let into the back piece nearly $\frac{1}{8}$ in., and is glued and secured with two screws. The back piece is fitted with the brass slot-screw plate as shown by Fig. 38. The screw is driven, leaving the head standing out about $\frac{5}{16}$ in.; the hole in the plate fits over it, and when the bracket is forced down, the neck of the screw goes up into the slot. The screw should be regulated to retain the bracket firm.

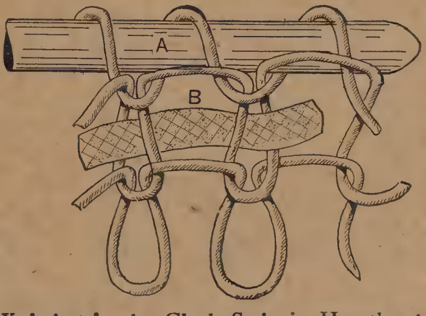
The brass rod is let direct into the scroll ends about $\frac{3}{8}$ in. deep, and is retained by the terminals, as in Fig. 39. The oak is best french-polished.

Making Hearthrugs from Cloth Strips

The hearthrugs here described are made from odd pieces of cloth, tailors' cuttings, old coats, trousers, etc., the cost of which material is very slight. The rugs are very warm and serviceable, and will last for many years. Two large steel knitting needles will be required, size 18 in. long and about $\frac{3}{16}$ in. or $\frac{5}{32}$ in. in diameter. The sharp ends of the needles must be rounded off with a file or on a grindstone, otherwise they will prick the fingers when in use. The cloth should be cut into strips about $\frac{3}{4}$ in. or 1 in. wide, and about 6 in. or 7 in. long. A ball of either knitting cotton or ordinary string will complete the materials required. It is assumed that the reader has some knowledge of ordinary knitting. The rugs are knitted in strips of about forty-three or forty-five stitches in width, the length of the strip being the required width of the finished rug. These strips are ultimately crocheted together to build up the finished rug.

The accompanying illustration shows the stitch and how the strip of cloth is knitted in, A representing the needle, and B the strip of cloth.

Begin making the strips by first casting on a number of stitches, say forty-three or forty-five stitches (it must be an odd number) on one needle. Now proceed to knit one plain row, and then start knitting in the pieces of cloth as follows: For the first row, lay a piece of cloth crosswise on the knitting, knit one stitch, and then turn the end of the strip of cloth over and knit again. Repeat this to the end of the row. For the second row, knit a row plain without any cloth, and for the third row knit in the cloth strips as for the first row. The fourth row is knitted plain as for the second row; continue in this manner until the required length of strip is completed. Having knitted a sufficient number of strips to make up the rug, they are crocheted together as previously stated. It is advisable not to attempt to knit the rug in one piece, as it would be too heavy to handle. If desired, the rugs may be lined at the back with canvas.



Knitting in the Cloth Strip in Hearthrug Making

Repairing Water Taps

THERE are two systems of water supply to houses, (1) the "constant supply," in which the water passes direct from the company's main to the taps, and (2) the "storage system," in which a storage cistern is provided, the height of the water in the cistern being regulated by a floating ball valve. The storage system is fast falling into disuse in consequence of the stagnation and pollution of the water standing in the cistern. In both these systems a stop-cock is provided on the branch house main from the company's main, and is usually found close to where the pipe enters the house or in an iron stop-cock box in the front garden. It is necessary for the reader to know how and where to cut off the supply before he can attend to a leaky tap; and it is for this reason that the above information is given.

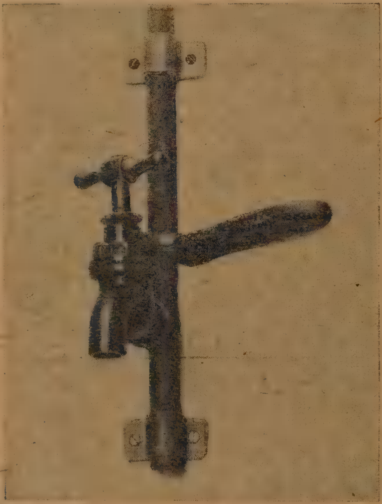


Fig. 1.—Taking Screw-down Tap Apart with Screw-wrench

Screw-down Cold-water Taps.—A badly leaking tap usually requires the washer to be renewed, but it does not follow that this will be a complete remedy. Very old taps may be worn out at the seating, which in the cheaper taps is very often badly machined and consequently does not afford an even bed for the washer; and in this case no amount of re-washering of the tap will prevent leaking. The only way out of the trouble is to get a new tap.

Take the case of an ordinary tap ("a screw-down bib cock") fitted to a ½-in. lead supply pipe. To re-washer this tap, the first necessity is to turn off the water at the stop-cock on the branch main, or to plug the outgo in the cistern, the plugging being managed by securing a wad to the end of a stick and pressing it into the pipe, by driving in a cork, or even by forcing in the prepared end of a broom-handle. Next turn on the tap and wait until the water ceases to flow. In the storage system, the cistern ball valve may be tied up so that no water can come through the branch main, and the cistern may then be emptied, but this method involves much time and trouble.

A spanner or wrench is then applied

to the square at the top of the tap (see Fig. 1), and this part unscrewed (see Fig. 2). The screw thread is left-handed—the reverse of an ordinary wood screw. A careful inspection of the mechanism of the tap should then be made. It will be found that the water passes up through the aperture seen at the base, by the seating for the washer, and thence through the nozzle of the tap. Fig. 2 shows the top portion of the tap raised above the lower part, the old washer and jumper, with cut screw at the end, being clearly shown. The turning of the cross lever or handle of the tap works quite independently in the top portion, and either presses down or raises the washer on the seating, turning the water off or on respectively. This continual action is the cause of the washer becoming worn out. Fig. 3 shows how the old washer is removed by means of a screwdriver which unwinds the screw at the base of the jumper A. The new washer is put on in the same position as the old one, and the whole is then tightened up. It is important to get the correct size of washer, and this is easily ensured by comparison with the old one. Washers are made of specially prepared leather, vulcanised rubber, rubber, and asbestos, and can be obtained from any ironmonger or builders' merchant at very small cost. Perhaps the vulcanised rubber ones are most durable, but to some extent the kind to be used depends on the class of tap for which the washer is required.

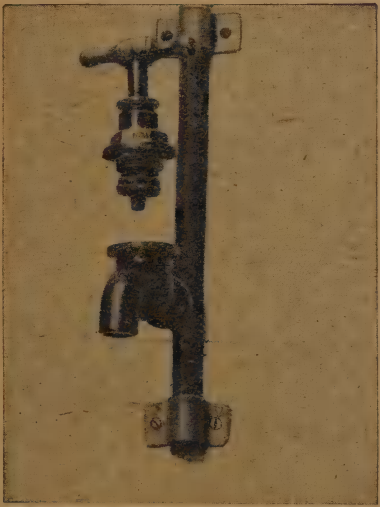


Fig. 2.—Parts of Screw-down Tap Separated

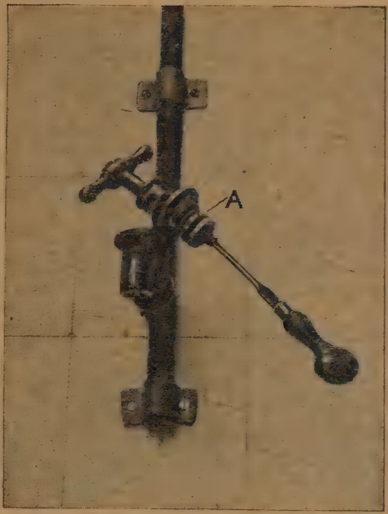


Fig. 3.—Removing Old Washer from Tap

By means of the spanner the two sections are re-screwed together tightly.

Screw-down Hot-water Taps.—In dealing with hot-water taps, the re-washering of the screw-down type is similar to the operation above described, using a vulcanised washer and not a rubber or leather one. "Dexine" washers are excellent for both hot- and cold-water taps.

Plug Taps.—For a plug tap with lever handle (a "gland valve") some special instructions will be necessary. This is almost always a hot-water tap.

First stop the supply from the cold-water cistern (usually situated in the roof) on the hot-water installation. This can be done in one of two or three ways. The stop-cock just below the cold-water cistern, should one be provided at this point, may be turned off; or one of the methods already described may be adopted. Of course, the fire will be out at the boiler while the work of repairing the tap is proceeding, and it is only necessary in any case to empty the system to the point where the defective tap is situated. Fig. 4 shows the tap on a $\frac{1}{2}$-in. iron supply pipe; on the tap is screwed an anti-splash nozzle. In Fig. 4 the tap is shown being taken off with a wrench adjusted to the back hexagonal nut formed on the tap; but it is sometimes convenient to withdraw the screws holding the sections together while it is firmly fixed to the wall, and in Fig. 5 this operation is shown being carried out.

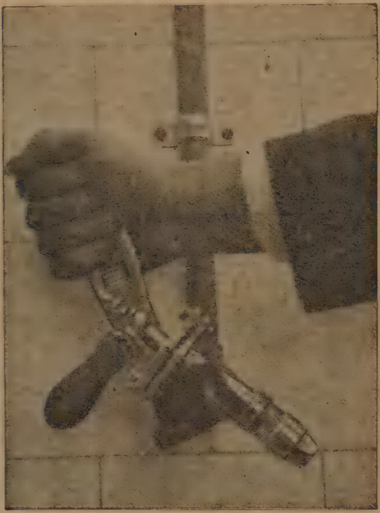


Fig. 4.—Removing Plug Tap with Screw-wrench

Wrenches of the necessary size are not always available, and the joint of the tap with the supply pipe is usually very tight and difficult to move. In Fig. 6 a method of winding it off is shown, but this naturally must be used with reason and care, so as not to force to breaking-point any of the parts; the method consists in securely cording a stout piece of wood to the tap, and then by the increased leverage so obtained unscrewing the base of the tap from the supply. A piece of iron, a stout screwdriver or short poker passed up the outgo of the tap will have the same effect, but must be used with great caution. It will be noticed that the top section of the tap has been removed in Fig. 6; it consists of the plug shown separately in Fig. 7.

The cause of this kind of tap leaking is that the surfaces of the base of the tap and the plug portion have become, by constant use, loose and uneven, allowing the water to find its way round the shank of the plug and out at the nose of the

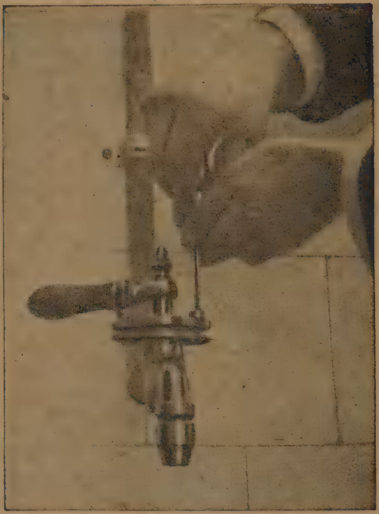


Fig. 5.—Unscrewing Top Part of Tap

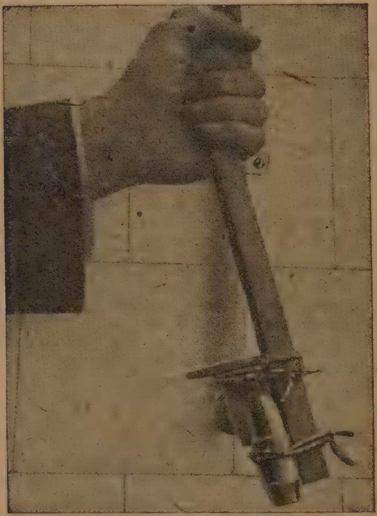


Fig. 6.—Removing Bottom Part of Tap

tap. Study of Fig. 8, which is a diagram section of this valve, will show that, to prevent leaking, the joint between the two sections must be perfect.

The mechanism requiring to be thoroughly overhauled consists of a plug, on to which is fixed a handle working in a ferrule fastened by two screws to the base casting of the tap. In this plug, which is of the same metal (brass, gunmetal, etc.) as the remainder of the tap, is cut a slot as shown, and when the tap is " off " this is turned away from the diameter of the pipe, thus preventing the water passing through the tap. It is illustrated in this position in Fig. 8, the handle being parallel to the wall. When the lever has been turned through a quarter-circle and the slot comes into line with the supply pipe and flow of water, the tap is " on." The dotted lines in Fig. 8 indicate the " on " position of the tap.

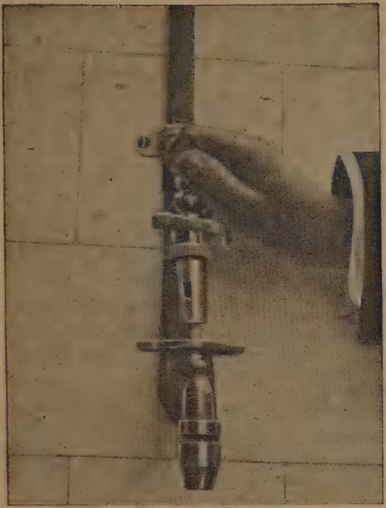


Fig. 7.—Plug Separate from Bottom of Tap

To get a true joint between the plug and the base section of the tap, grinding-in is necessary. This operation, as shown by Fig. 9, consists in taking a little emery powder and paraffin oil, placing it in the base of the tap, and by continual rotation in complete circles working the surfaces true to each other. It is a somewhat laborious task. Care must be given to see that the plug is not allowed any side play, and that it is kept exactly upright in its socket. Should the plug grind on the bottom of the base section so that it cannot work in any farther a $\frac{1}{8}$-in. can be cut off the end with a hack-saw to permit it to go lower.

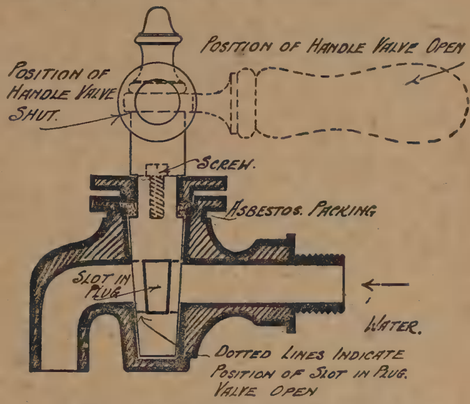

POSITION OF HANDLE VALVE OPEN
POSITION OF HANDLE VALVE SHUT
SCREW.
ASBESTOS. PACKING
SLOT IN PLUG
WATER.
DOTTED LINES INDICATE POSITION OF SLOT IN PLUG. VALVE OPEN

Fig. 8.—Section Through Plug Tap

Having satisfactorily finished this part of the repair, the reassembling of the tap can be undertaken. This necessitates the renewal of the asbestos packing shown in Fig. 8, this consisting of asbestos strands wound round in just sufficient quantity to pass into the groove to receive them and then pressed tightly into place by the action of the screws with the top brass shaped ferrule. This ferrule, or washer,

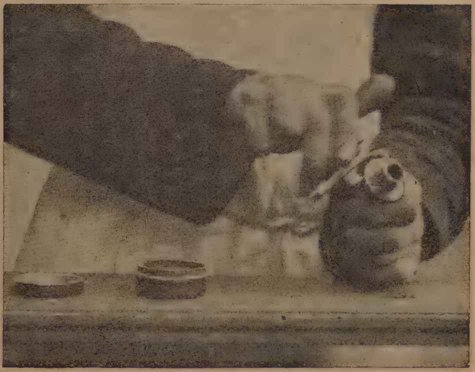


Fig. 9.—Grinding-in a Plug Tap

as it may be called, is seen raised in Fig. 7, in which illustration the slot in the plug is clearly shown. The tap has now to be re-connected to the supply. The joint here is made of red-lead and hemp in manner following: Red-lead and linseed oil in the consistency of thick paint is applied to the thread of the tap, and then strands of hemp are wound tightly round it. A very little red-lead is applied to the inside thread of the bend to receive it. Then all is tightly screwed up.

When refilling the system with water, the taps on the lower part of the system should be turned a trifle on, while those on the upper portion should be full open, so as to allow the water as it rises in the services, etc., to force all air in the pipes before it. To see that all is in proper working order, set the fire going at the range and draw hot water from each of the points on the several services.

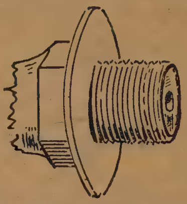


Fig. 10.—Bore of Cock Reduced with Washer Soldered On

REDUCING EXCESSIVE OUTFLOW AT TAPS

When it is anticipated that the water pressure at a tap will cause the outflow to be excessive and violent, the customary plan is to use screw-down cocks, which are comparatively slow in opening and closing, this being in itself sufficient to obviate any inconvenient results due to excessive pressure when the taps are opened. There are, however, numbers of instances in which the screw-down tap cannot be used, and a sudden-opening and sudden-closing cock—that is, some kind of plug-cock—becomes necessary. This is when the only movement required to open or close the cock must be a single quarter turn to the right or left. Some surgical and dental requirements are only met by using a tap that can be opened and closed with the elbow, the hands being occupied with something else or possibly being in an unfit state to touch anything. In busy kitchens, too, taps that cannot be opened and shut in an instant are considered a nuisance.

When a plug-cock has to be used and the water pressure is high, the force of the outflow can be reduced by the simple expedient of reducing the size of the hole or bore in the tail of the cock. The tail is that part which has a thread screwed on the outside for attachment to the supply-pipe. The reduction in the bore is made by soldering a small brass washer on it, as shown in Fig. 10.

It does not follow that the pressure from a public main is the only cause of a violent outflow. In high houses, where the cistern may be 60 ft. above the kitchen taps, the pressure (from the cistern) is such that if a pan is held beneath a kitchen tap, and the tap turned full on suddenly, the outflow will possibly dash the pan out of the hand. This applies to both cold and hot taps in houses as high as those referred to. In instances such as these, the writer has found it necessary, on the lowest floors, to reduce the bore in the tails of $\frac{3}{4}$-in. cocks to $\frac{1}{4}$ in.

No exact rule or table has been worked out, but experience has shown that, with $\frac{3}{4}$-in. taps, the bore may, with advantage, be reduced as follows:—

Head or Pressure of Water		*Reduce area of aperture in tail or screwed end of tap to*
In ft.	*In lb. per sq. in.*	
40	17	$\frac{3}{8}$ in.
60	26	$\frac{1}{4}$ "
80	34	$\frac{3}{16}$ "
100	43	$\frac{1}{8}$ "

Fretcutting in Wood and Metal

Tools.—Improved materials and methods have done much to make fretcutting much more popular than it has been hitherto. For the beginner, the following is a list of tools best suited for the purpose :—A 14-in. saw-frame (iron is preferable for the beginner), one having a pair of good clamps top and bottom to hold the saw-blade. Tension may be secured in two ways — by the top clamp or by a screw in the handle operated by a turn of the wrist after the saw is threaded up; these frames may now be purchased quite as cheaply as the old and common pattern. There is a variety of fretcutting machines available, their obvious advantages being speed of working, and the fact that both of the hands are left quite free.

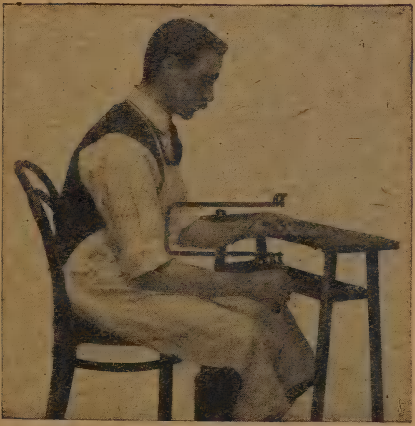


Fig. 1.—Position of Fretworker

A suitable cutting-board and cramp may be bought for a few pence. A wooden cutting-board with a V-shaped opening will be found quite adequate. Metal cutting-tables are more expensive and are considered a luxury; but they are liable to injure saw blades.

For boring holes in the wood an Archimedean drill is necessary. A bradawl or other pointed instrument should not be used, as it is likely to split the wood. The best kind of drill is that which has a small spring in the handle, because it assists in the withdrawal of the bit and prevents side-jerking, a common cause of broken drill bits.

A supply of glasspaper is also required; No. 2 medium for removing the design, No. 1½ for cleaning the surface, and No. 1 for finishing. A suitable pad or block is necessary for holding the glasspaper to the work; the one shown by Fig. 2 will be found an improvement on the ordinary cork pad. A strip of glasspaper is placed as shown on B; the part A is placed over B, and owing to the roughness of the paper it holds itself firmly against A. Such a block can easily be made, and serves all purposes.

A small screwdriver, hammer, small brads or nails, a tube of liquid glue, a dozen or more saws, and the outfit is complete.

Saw-blades can now be obtained at

extremely low prices; but for really good work, a high-quality saw-blade is absolutely necessary. For turning sharp corners a medium blade with sharp, well-defined teeth is recommended. Saw-blades having short, closely set teeth are much too slow for general work. The American "Star" saw still enjoys a great deal of favour, but those saws with rounded backs, which enable corners to be turned without leaving behind them any visible trace, are to be recommended.

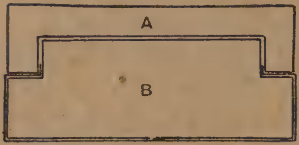


Fig. 2.—Glasspaper Pad

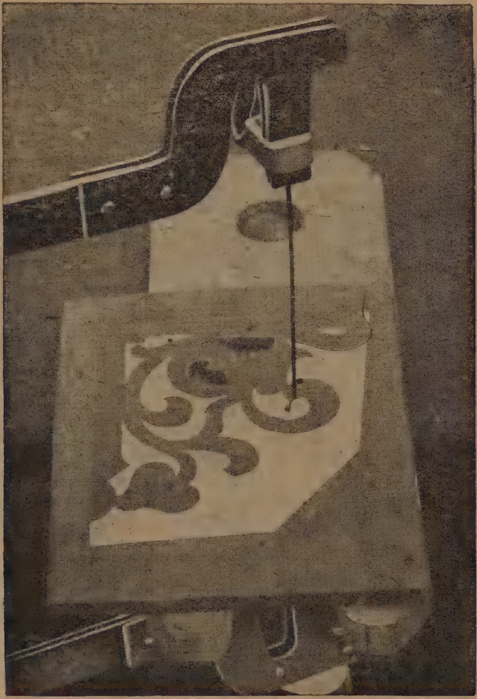


Fig. 4.—Cutting Inside Curve

Pasting Down the Design.—To begin the actual work the design is pasted on to the wood, and it is necessary to note that this must be the way in which the grain runs, not across it. The paste must be applied thinly and evenly on the design (not on the wood), and the design deftly laid on the wood, the pattern being smoothed down with the palm of the hand or a soft rag so as to exclude all air and force out wrinkles. A paste made of starch boiled to a thick jelly, in which a small piece of gum arabic has been dissolved, is the best adhesive. It adheres to the wood firmly, but can be removed easily by the finest glasspaper. A few drops of oil of cloves added to the paste will preserve it.

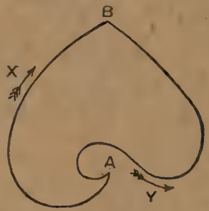


Fig. 3.—Method of Cutting Corner

The Sawing.—The holes are drilled in the waste portions of the design—if possible opposite some projecting point—and the saw threaded up. The work is then firmly held down to the cutting-table with the left hand, and the fingers spreading over the work at the back of the saw. The cutting is then proceeded with, the hand-frame being held perfectly upright with a firm grip, so as to completely control its movements. Use a steady, regular stroke, feeding the work gradually to the saw, otherwise the edges of the fret will be irregular. Some workers move both the saw-frame and the wood; but to the beginner this is a dangerous operation, as it requires skill, only acquired by practice, to perform the double action perfectly. The worker quickly learns to keep the saw upright, and the left hand soon accustoms itself to holding down and feeding the work to the saw. If the worker possesses a treadle fretsaw, he has the advantage of having both hands free to guide the work, and the saw is always in an upright position, consequently there is only the guiding of the wood to the saw with which he has to contend. It is important to note that in all cases the saw teeth must point downwards, otherwise the upward stroke brings the dust up through the saw line, and if the pattern is pasted to the wood it raises it, and, naturally, the effect of this deters even experienced cutters from following the line of the pattern. Fig. 1 is a photographic view showing a fret-saw in use.

Turning Corners. — The beginner's first difficulty lies in the turning of corners accurately. There are two methods given here which will help. Suppose that in cutting a hole the saw begins at A (Fig. 3) and cuts to the corner B, by way of the arrow X. The saw may then be drawn back, beginning again at A, sawing to B in the direction indicated by the arrow Y (see also the photographic view Fig. 4). Another method, and a much quicker one, is when the saw reaches the corner Z (Fig. 5) to withdraw it a little and cut its own width in the waste portion towards the line. The small hole thus formed allows the saw to be turned without any breakage, the corner being cut clean and perfect. The beginner, however, after a little practice, will be able to turn corners without the use of these two artifices; but, of course, much depends on the quality of the saw-blade; and if a No. 1 or No. 2 blade is being used, the corner can be comfortably passed without any fear of the saw breaking or leaving an ugly or rounded corner.

Outside Points, etc. — The cutting of the outside of the design is usually left until all the inside of the design has been finished. The only exception to this is when most of the inside is to be cut away, as is the case with overlay borders. In these circumstances it is always advisable to cut the outside first, because if the inside were cut away it would leave the work weak across the grain, and it would require exceptionally gentle handling afterwards.

Outside points are in some respects more difficult to turn than corners. However, the beginner may easily overcome the difficulty by making a round turn in the waste wood opposite, and, keeping well on the outside of the line, proceed to cut again. This is shown in Fig. 6 by the dotted line Z, and also in the photographic view, Fig. 7. Long, tapering points require care in cutting, otherwise they are liable to snap off. To do this successfully the work must be drawn to the corner of the V-slot in the table, and the wood pressed well down and fed up only as little as possible.

Finishing off.—When the work has been cut out it is ready for finishing off. If there are slots and tenons for the fixing of a shelf or support these should be measured previously, as it is desirable to have a perfect fit without relying too much on nails and glue. Tenons might be made a shade longer, and taken off afterwards with a small plane or chisel.

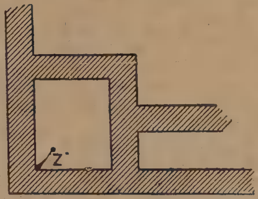


Fig. 5.—Another Method of Cutting Corners

The outside edges of shelves and other work having a continuous straight cut are often left uneven, and if these cannot be altered or made correct by using the saw they are best left alone. A small plane might be sometimes used with advantage; but the worker is not advised to use metal templates, which are either screwed or fixed with pin-points to the wood. The saw, when travelling along the side of a template, is liable to be pushed out of truth, thus sawing out of the vertical, and its edge is either dulled or broken by constant friction against the metal. A better method in place of templates is to draw a sharp knife-blade along the line, making a groove for the saw to run. These methods, however, are never used by experienced fretcutters.

The glasspapering must be done

thoroughly on both sides of the work, whether they will be seen or not. The swarf or roughness round the frets is first removed, and then the paper design, if it has been pasted on. Water should not be used, as it warps the wood; glass-papering is the safest method that can be employed. At this stage the worker will probably see his work much clearer, and any small diversions from the line of the pattern will be easily noticed; an attempt to remedy this with files will most likely result in making it worse, because files are not adaptable to woodwork, especially when they are used across the end grain of delicate frets. Strips of glasspaper glued on shaped pieces of thin wood are more suitable, but not to be altogether recommended.

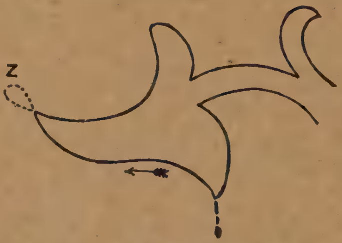


Fig. 6.—Method of Sawing Delicate Points

Straight sawing requires practice, and if the beginner has mastered the earlier stages of sawing straight lines and curves it should not be difficult for him to turn out fair work by his first attempts.

Polishing, Varnishing, etc. — The wood, having been finished with the various grades of glasspaper, now assumes a somewhat polished appearance, and here it may possibly occur to the fretworker that his work should be finished with a french polish or varnish. The writer has often seen delicately and excellently cut frets coated with thick varnish which would have been more appropriate for a street door. It seems to be the desire of many workers to see their work under a coat of polish. Some workers have a very crude knowledge of the art of french polishing, and proceed to smother the fret with linseed oil, russian tallow, or other grease, and then to experiment with french polish, in most cases covering the edges of the frets, thus causing the wood to warp.

French polishing, varnishing, etc., are difficult operations to manage satisfactorily, and the beginner is advised to refrain from using liquids of any kind on delicate work. Portions of cabinet work, etc., of a substantial thickness may be french-polished, but ordinary fretwork, owing to the appearance of dullness on the inside of the frets, is not suitable for french polishing.

A much better polish, which does not warp the wood, and which will not show dullness in the frets as much as liquid polishes, is made by adding just a few drops of spirits of turpentine to some shredded beeswax, and melting to form a thick paste (not a fluid). This should be used very sparingly on a pad made from a piece of stiff felt, a good pressure and a brisk rubbing in the direction of the grain giving excellent results.

Fitting Together.—So far, it has been assumed that the fret has been of a plain character, such as a bracket, in which case the shelf and support would, of course, require to be fixed. If nails are used in any piece of fretted work it should be remembered that all hammering must be reduced to a minimum. Holes should be drilled with a fine bit in the back of the work, and the nails gently driven through into the shelf or other portion which is desired to be fixed. All joints, except those intended to be taken apart for cleaning, should have a touch of glue given them as an extra security. Screws also are more serviceable than nails, and have the advantage of making the work more superior, besides allowing for the work to be taken to pieces when required. Clock cases should invariably be screwed, so as to allow for the regulating or repairing of the timepiece.

A wooden vice is a handy tool for assisting the fretworker to fit up his work, because all parts may be securely held in position whilst being nailed or screwed.

Overlays.— Overlays, such as those which form rebates for photo frames, mirrors, etc., should be cut from woods not more than $\frac{1}{16}$ in. thick, otherwise a heavy and clumsy appearance is given to the article. These thin woods should always be cut between two waste pieces, nailed together with fine nails, the design being pasted on the uppermost piece. Any holes which are to be pierced should be drilled with a sharp bit, using only sufficient pressure to force it through the wood. The outside is then sawn with a No. 1 saw-blade, and the inside, which is secured with the nails, is sawn last.

If the overlay is an ornament with interior fretting, this should be cut first, and the outside left until the last. Afterwards it should have the swarf cleaned away from the bottom edges with No. 1 glasspaper, and, without further attempting to clean it, it should be glued into position under pressure. Any heavy article will suffice to lay on the overlay, and the latter may be protected by a piece of fretwood. The overlay can be glasspapered and cleaned up after the glue has set.

Duplicating Designs. — Fretworkers frequently find that only one drawing of some of the smaller parts is given on the design sheets, and yet two or more of these are required to be cut. The worker usually proceeds to trace the parts off by means of carbon paper or by the use of heelball after the part is cut out. The former method is tedious, and the latter has the disadvantage of reproducing any mistakes in cutting which have been made.

The experienced fretcutter would overcome this difficulty by sawing two or more pieces of wood at one time, but the beginner is not advised to practise plural cutting until his work is perfect.

Methods are here given by which any parts may be easily duplicated. The first is by means of transparent paper, which may be purchased from any artists' depot. This is laid over the design and secured with drawing pins, and with a blacklead pencil the outline is accurately traced. The second method is exceedingly useful, especially for small parts, and is not generally known to fretworkers. Take some common yellow soap, shred it fine, cover with water, and apply heat until it forms a thick jelly; then add spirits of turpentine, mixing it well until a paste is formed. This is thinly smeared over the face of the design, which is laid on a piece of paper and placed between the leaves of a book under pressure, and a clear reproduction of the design will be the result.

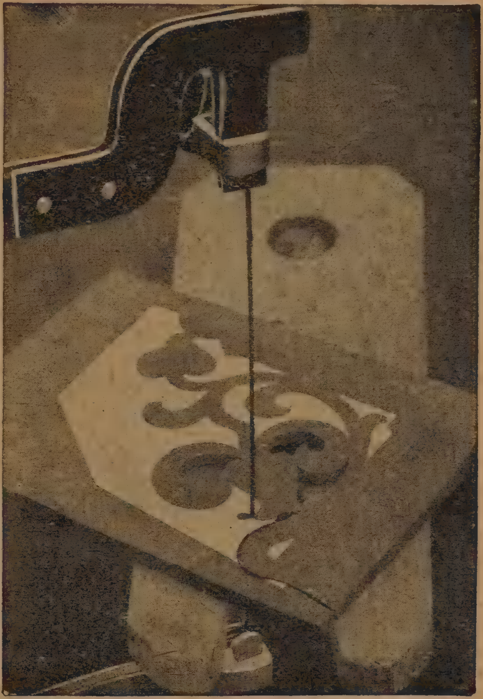


Fig. 7.—Cutting a Point

Reversing Designs.—Often it is desired to reproduce a design in opposite positions—that is, left and right—to form a pair. Plural cutters would cut two patterns at once, completely reversing the under one, but taking great care to remove the fine shreds of swarf, and thoroughly cleaning it up. This is the simplest way out of the difficulty, but the writer devised a method by which anyone can easily reverse the position in the usual way. Mix 2 parts of castor oil, 1 part raw linseed oil, and 1 part methylated spirit in a bottle, and shake the mixture up well. The product should be an opaque lemon-coloured liquid. The design is pasted on the wood face downwards. The liquid is then thinly applied with a rag, and immediately the paper becomes transparent and the design can be clearly seen. It also has for its credit quick drying, and is not injurious to the wood. Greasy compounds, such as butter, lard, and other fats, must not be used, as they grease the hands and the work.

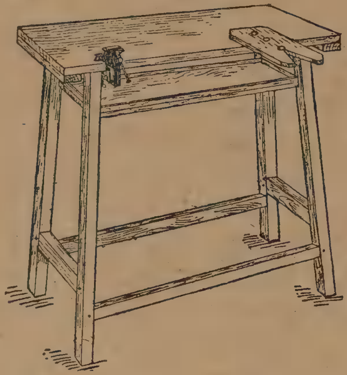
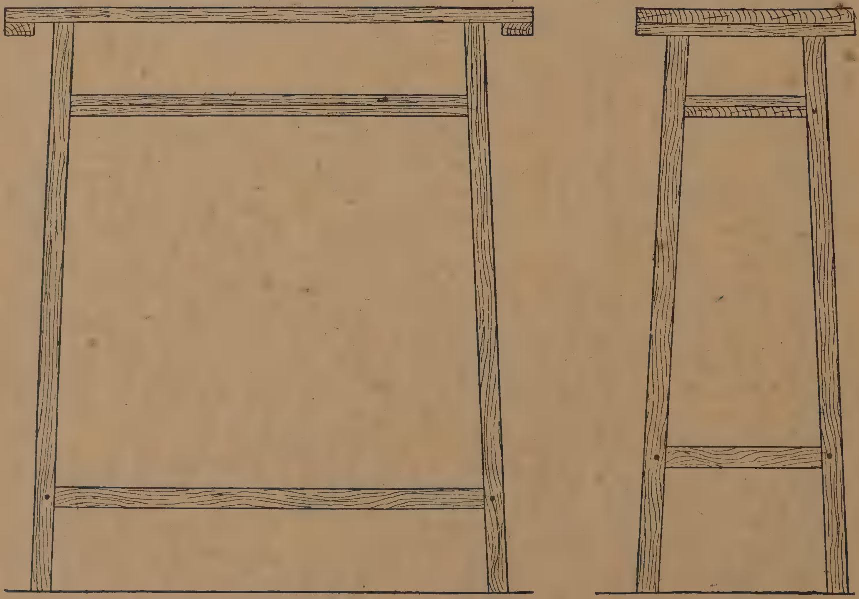


Fig. 8.—Fretworker's Table

A FRETWORKER'S TABLE

The fretworker's table shown by Fig. 8 is easily and cheaply made, and, although light, is quite firm. When the cutting-board is unscrewed and removed the table can be utilised, if covered with a long cloth, as a side table for a sitting-room. Figs. 9 and 10 are front and end elevations of the table without the attachments.

To make the table, first prepare four pieces of yellow deal, free from knots, 2 ft. 5½ in. long by 1 in. sq. (1-in. quartering is used for all the framework), for the legs, which should be spread 1 in. from the perpendicular; the top end of these legs should be cut at an angle to correspond with the top of the table. The legs are connected 4 in. from the bottom in the front and back by two rails 2 ft. long, and at the sides 6 in. from the


Figs. 9 and 10.—Front and End Elevations of Fretworker's Table

bottom by two rails 9 in. long. These rails are tenoned into the legs as shown in Fig. 11; and after they have been put together and glued, wooden dowels are driven through the joints to give further strength. The top is 2 ft. 3 in. by 10 in. by $\frac{3}{4}$ in., and should be of hardwood, such as oak or beech. The legs are let $\frac{3}{8}$ in. into the top, $1\frac{1}{2}$ in. from the front and back edges, and $2\frac{1}{2}$ in. from the ends. Two pieces 10 in. by $1\frac{1}{2}$ in. by $\frac{3}{4}$ in. are screwed under the ends of the top to prevent it from warping (see Fig. 12).

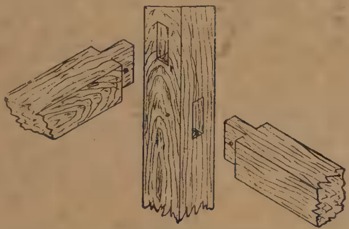


Fig. 11.—Mortise-and-tenon Joints of Rails and Legs

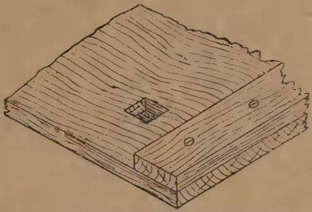


Fig. 12.—Ledge on Table-top to prevent Warping

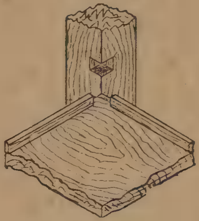


Fig. 13.—Joint of Shelf and Legs

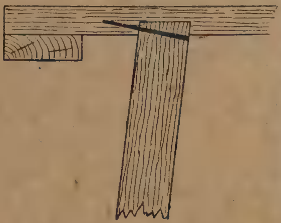


Fig. 14.—Securing Legs to Top

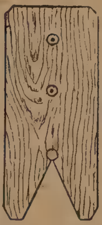
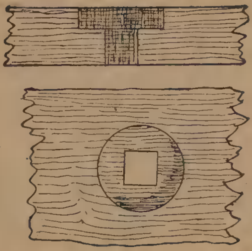


Fig. 15.—Cutting-board

Fig. 17.—Butterfly Nut

Fig. 16.—Bolt



Figs. 18 and 19.—Fitting Bolt in Cutting-board

Between the table top and the lower rails a shelf of $\frac{1}{2}$-in. stuff should be fixed for use as a receptacle for tools or some of the small finished work. Square notches to receive the shelf should be cut out of the legs, 4 in. down, and a small beading tacked round the edge of the shelf, neatly mitred at the ends to fit the legs (see Fig. 13). Care should be taken that the shelf fits tight in the notches; in fact, it would be better to cut the notches $\frac{1}{16}$ in. less than the shelf, so that after the shelf has been smoothed up it can be driven in quite tight.

All the necessary parts having been prepared, they should be glued together, after seeing that the tenons in the rails fit accurately into the legs. Glue in the front and back rails first, and then the two side rails. Next, take the shelf, which should have been already beaded, and glue it into the legs, and cramp it up. If a cramp is not available, get some stout cord and wind it round the legs, placing pieces of cardboard under the cord at the corners to prevent it from marking the legs. When the framing has properly set, the top may be glued on and the table set aside for several hours. When the table is ready for further handling, $\frac{1}{4}$-in. holes should be bored through the connections of the rails and legs, and wooden dowels driven in. A pin or dowel should also be driven through the legs into the top, as shown in Fig. 14.

The cutting-board (Fig. 15) may be made of any close-grained wood, and should be fixed perfectly rigid. Procure a piece of oak or beech, and plane it to 9 in. by $3\frac{3}{4}$ in. by $\frac{1}{2}$ in.; then cut out of one end a **V**-shaped piece 2 in. wide at the base and $2\frac{1}{2}$ in. long; this forms the mouth for the working of the saw. At the point of the **V** bore a $\frac{5}{8}$-in. hole, as shown, which acts as a safeguard against damage by the bit. When being bored, the work is so placed on the cutting-board that the bit comes over this hole, so that when the bit has pierced the work no damage will be found to have been done to the cutting-board; but this method is liable to splinter the under surface of the work unless it is backed by a waste piece of wood.

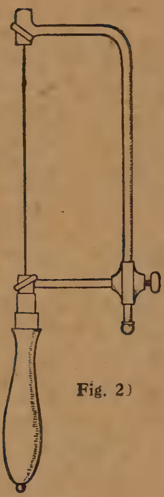


Fig. 20

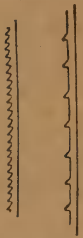


Fig. 21

Fig. 20.—**Jeweller's Saw**

Fig. 21. — **Fretsaw Blades for Metal and Wood Respectively (Enlarged)**

To fasten the board securely to the table, procure a small $\frac{1}{4}$-in. bolt with a butterfly nut (Figs. 16 and 17). Place the board in position on the table and bore a $\frac{1}{4}$-in. hole through both, and insert the bolt. To make the latter come flush with the top of the board, the board will have to be cut as shown in Figs. 18 and 19. The square part in the neck of the bolt will prevent it twisting round when screwing on the nut. Two of these bolts should be fitted, as indicated in Fig. 15. The table should also be provided with a small fretworker's vice. To complete the table it should be smoothed up, well glasspapered, and stained. Apply two coats of hot size, and, when dry, rub down and apply a coat of oak varnish.

METAL FRETWORK OR SAW-PIERCING

Metal fretwork, or saw-piercing, is an important branch of the metalworker's art, being frequently employed in conjunction with repoussé and sheet-metal work. Wood fretwork is capable of considerable improvement by the introduction of pierced metal overlays, especially with such things as decorative hinges and lockplates; consequently, a knowledge of the method of working is not only necessary to the metalworker, but also to the fretworker in wood who aspires to work of a high order.

Materials and Tools.—The materials for the work are easily procurable; sheet-metal suitable for piercing can be obtained from all dealers in metalworkers' requisites. The special saw frame sold for metal piercing differs from the woodworker's fretsaw frame in that it has less sweep, and is stronger. A somewhat different variety of saw frame used for fine work, known as a jeweller's saw, is shown in Fig. 20. Its chief advantage is its movable back, secured with a thumbscrew, that enables a short length of broken saw to be replaced in the frame. For occasional work an ordinary woodworker's fretsaw will be found fairly efficient.

Of great importance is the kind of saw-blade used. It is useless to attempt to work with a woodworker's saw-blade—one with wide teeth—although this is often done, with the result that the saw breaks with the extra strain put upon it, and if it cuts the metal at all, it is in a nasty jagged line. Special saw-blades are sold for metal cutting, and these only should be used; they have teeth so fine as to be almost imperceptible to the eye except the blade be held up to the light. The difference between the two is clearly shown in Fig. 21. No. 00 is a useful grade.

FRETTING BRASS

Lockplate Designs.—Metal fretwork becomes extremely useful for the enrichment of small articles of furniture. Ornamental lockplates and hinges (Figs. 22 to 32), if well designed and cut, enhance the appearance of such. In the Middle Ages the application of pierced-metal enrichments of this kind, that had also a useful purpose, was very common indeed, and hinges and lockplates were of most extravagant dimensions. Figs. 22 to 27 show a variety of designs for pierced lockplates based upon the grape-vine, for executing in brass, and these would form simple exercises for a comparative novice. Brass is easy to cut, and is one of the best metals to start with, and the designs have the advantage that, being small, no great waste of metal can result.

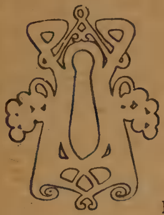


Fig. 22

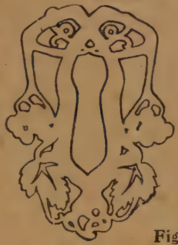


Fig. 23

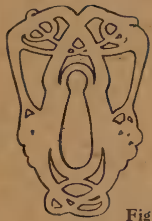


Fig. 24

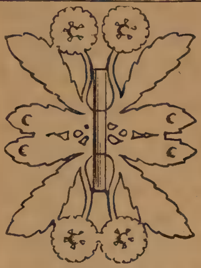


Fig. 28

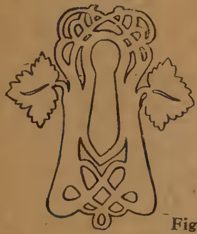


Fig. 25

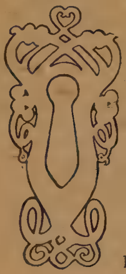


Fig. 26

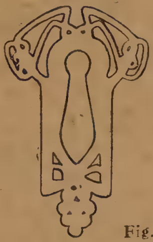


Fig. 27

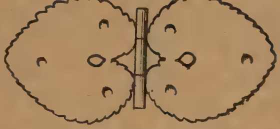
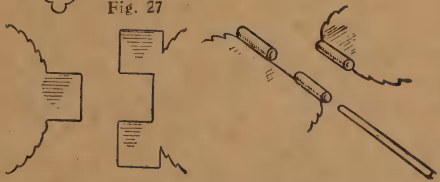


Fig. 29

Figs. 22 to 27.—Lockplate Designs

Figs. 28 to 32.—Hinge Designs


Figs. 33 and 34.—Hinge Joint

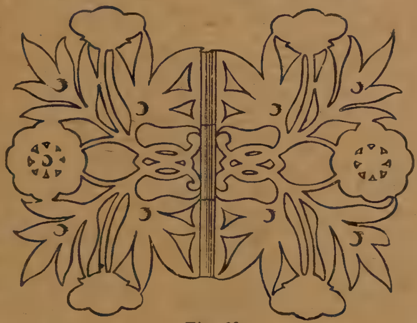


Fig. 30

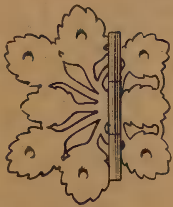


Fig. 31

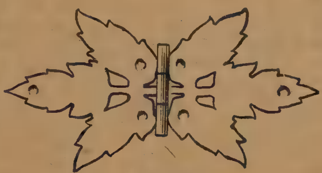


Fig. 32

The simplest method of reproducing the pattern is to stick a tracing on the metal. If ordinary gum or glue is used the tracing is liable to peel off upon drying; but there is no liability of this trouble if the paste used consists of starch 1 part, white sugar 4 parts, and gum arabic 1 part. Place the gum arabic in a piece of muslin, and soak in water overnight; then add the starch and more water, and boil till it thickens.

Paste down the tracing, and allow to dry before drilling the holes for threading the saw. A small cutting board with a V-shaped opening in it, clamped to the bench, will form a support large enough for cutting out these small designs. In sawing, it is best to move the saw rather rapidly, but not to exert any forward pressure, merely a downward one. Upon completion, remove the paper pattern with hot water, and proceed to correct the outlines with the very fine files known as needle files, which may be obtained so fine that they will be found to enter all but the smallest interstices. They are employed for truing cuts incorrectly made, and for making the sharp angles which are very difficult to cut with the saw. Finally, vigorously rub the work with a cork and pumice powder, to remove the burr and sharp edges left by the saw.

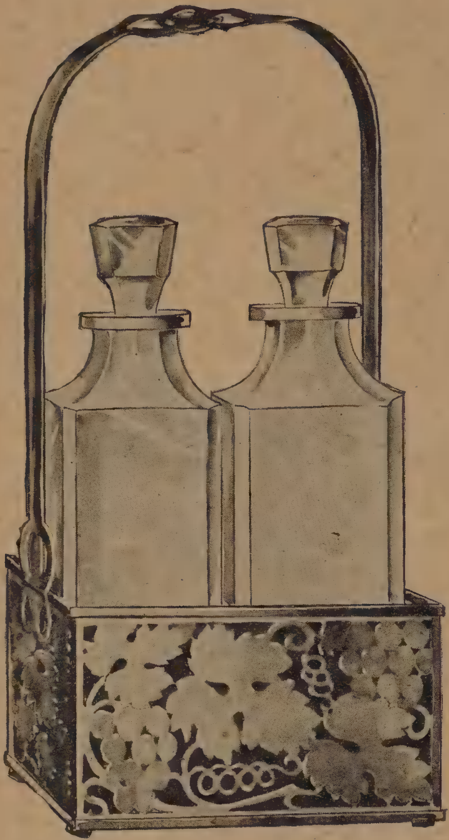


Fig. 35.—Cruet Stand

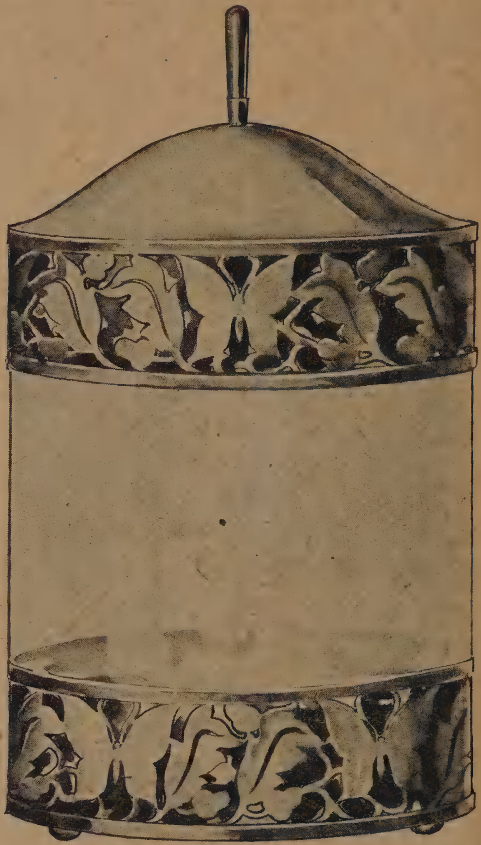


Fig. 36.—Biscuit Holder

Hinge Designs. — In executing the hinges shown by Figs. 28 to 32, cut the edges that abut one another, as in Fig. 33. The tongues, two on one portion, and one on the other, are bent up to form a thin cylindrical tube in three sections, through which is passed a wire that fits easily; the wire is burred up at the end to prevent it slipping out (see Fig. 34).

FRETTING COPPER AND PEWTER

The designs shown by Figs. 35 and 36 are intended to be worked in copper for subsequent electro-plating; or they could be executed in german silver or pewter.

Fig. 35 shows a small cruet stand, the size of sheet necessary for a convenient-sized stand being given by Fig. 37. These measurements may need adjustment to individual requirements. The patterns for piercing the sides, front and back are given in Figs. 38 and 39. A piece of metal measuring 12 in. by 2¼ in. is first cut for the front, back and sides, these all being in one piece, and the measurement including a ¼-in. lap for turning over.

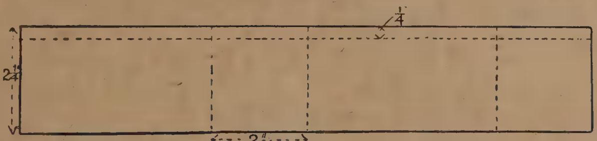


Fig. 37.—Metal Sheet for Making Cruet Stand

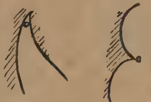
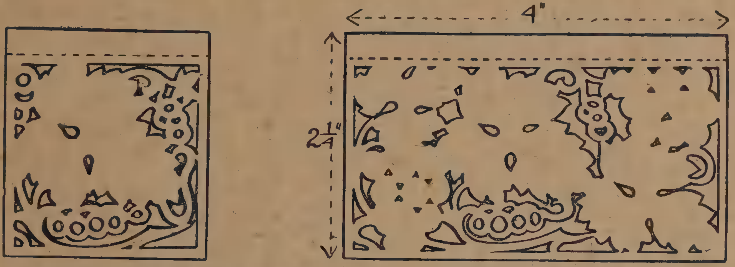


Fig. 40.—Working the Corners



Figs. 38 and 39.—Patterns for Sides, Front and Back of Cruet Stand

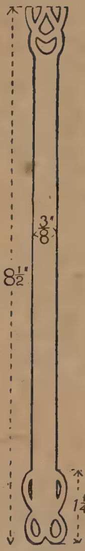


Fig. 44.—Half Pattern for Handle

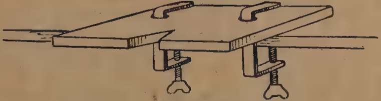


Fig. 41.—Sawing-board Clamped to Table

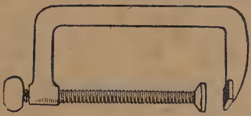


Fig. 42.—Screw Clamp

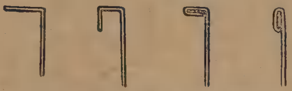


Fig. 43.—Seaming the Top Edge

The first thing to do is to mark the size on the metal, taking care to obtain all the lines accurately at right angles to one another, and to get the two opposite portions exactly the same size. Cut out with shears and planish or smooth the front surface of the metal. Take a full size tracing of the piercing, guided by the illustration, Figs. 38 and 39, and proceed to transfer the pattern of one side on to the metal. The means usually adopted is to prick round the traced outlines with a needle, making the holes about $\frac{1}{16}$ in. apart, to lay the metal sheet flat on a board, and then to pin the pricked tracing (the stencil) over it in the correct position. Tie up some finely powdered chalk in a muslin bag, and dust over the stencil, the chalk passing through the pricked holes and thus reproducing the pattern in minute dots on the metal. The lines are then painted round with a fine brush charged with brunswick black thinned with turpentine. Other methods are to pencil the design on the metal and paint over the lines, or to gum the paper pattern upon the metal, as previously mentioned; these are quite satisfactory means, and the worker can please himself as to which method he adopts. The only disadvantage of the last method is the liability of the paper to tear during the drilling.

The experienced craftsman's ideal method, especially when working in the precious metals, is to engrave the outline. Precious metals take pencil lines better if first smeared with gamboge, a lump of which can be bought at a chemist's for a few pence.

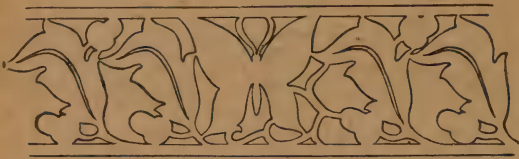


Fig. 45.—Repeat of Design for Biscuit Holder

Some workers transfer the pattern to the prepared sheet of metal by means of a carbon sheet which is inserted between the tracing and the metal, the design being then carefully engraved with a pointed instrument, so that the pattern is indelibly fixed to the metal, and will not be obliterated by the subsequent process of sawing out.

In enlarging out a pattern full size, and taking the tracing, care must be taken to leave plenty of attachment for every detail of the design with the surrounding framework. A leaf that is only supported at the junction with the stem and at its tip by a narrow strip of metal is very liable to fracture in ordinary use. All details should abut each other wherever possible; it is far better to cut away too little metal in the design than too much, as undue heaviness can be remedied afterwards with the files.

Before beginning to pierce, all the holes through which the saw is to be threaded should be drilled. The simplest means of doing this is to use a small piercer with the sheet laid flat on a hardwood block. An archimedean drill stock used with a fine bit is a fairly good method, only the extra pressure required is rather liable to break the bit. In drilling it is always best to select the most angular corner in each interstice, as shown in Fig. 40, it being quite impossible to turn the saw at such a sharp angle, which is finally made with a file.

During the sawing, the metal requires to be clamped on to the working bench or table in such a position that the portion being worked upon is free and unsupported. The usual method is to work on a board clamped to the working table, the board having a V-shaped cut in it—the portion above the V-shaped cut being that worked upon. Fig. 41 shows a suitable board clamped to the work table; the metal is clamped to the cutting-board, with clamps similar to that shown by Fig. 42, a thick pad of paper being introduced between the metal and the clamps, to save damage.

The sawing of the pierced parts of these particular articles requires a saw with at least a 12-in. sweep. A woodworker's strong fretsaw frame would serve, this having a wider sweep than the metal ones; but be sure to obtain the proper blades. The saw-blade is clamped to the bottom of the frame with teeth pointing downwards; it is passed through a hole in the metal, the upper part of the frame being bent inwards while the other end of the saw is clamped, so that it is tightly stretched. Begin by cutting away the smaller portions of the pattern first, leaving the larger interstices until last, so as not to weaken the metal

Fig. 46.—Use of File in Shaping Corners, etc.

unduly during the early stages of the cutting. The beginner's chief fault in metal sawing is that he endeavours to work too quickly. Metal sawing is very much slower and more laborious work than wood fretwork. The cutting requires a much freer stroke with practically no forward pressure. Lubricate the saw frequently with oil, and rest awhile should it become hot.

When all the open parts have been removed, amendments are made with the files (see Fig. 46), especially at the corners and sharp angles. Absolute accuracy is very much more difficult to obtain in metal than in wood, so that a good deal more after work has to be done. Finally, the work is vigorously rubbed with a cork and pumice powder, to finish off the edges.

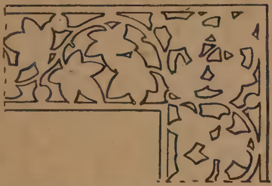


Fig. 47.—Photograph-frame Border

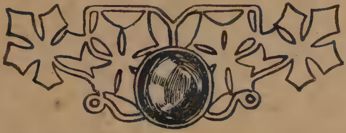
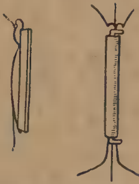


Fig. 48.—Brooch


Figs. 50 and 51.—Forming Hook for Waistbelt Clasp

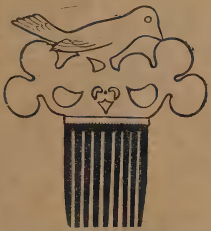


Fig. 52.—Small Hair-comb

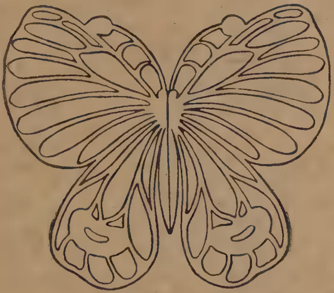


Fig. 49.—Waistbelt Clasp

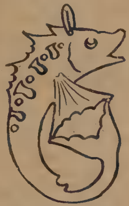


Fig. 53.—Pendant

After the pieces that constitute the sides of the article shown by Fig. 38 have been pierced, the next process is to form the seam of the top edge. This is produced by tapping the metal on a hatchet stake to a scribed line with a mallet, to bend it. Fig. 43 shows the four stages of the work. The sides are next bent up and soldered at the join. The bottom consists of a sheet of metal measuring $4\frac{3}{16}$ in. by $2\frac{3}{16}$ in., the turn-up of the edge being $\frac{1}{16}$ in. Turn up and try for a fit, and, when satisfactory, solder. Cut the handle, one half of which is shown by Fig. 44, and rivet and solder in place.

In making the biscuit holder shown by Fig. 36, the glass container should be obtained first, the exact circumference measured, and the metal cut accordingly. One repeat of the design for piercing is given in Fig. 45.

FRETTING SILVER

Working in silver is not such an expensive pursuit as one might be led to imagine. An ounce of silver of medium thickness will be more than sufficient to make one of many useful articles. All silver scraps and cuttings can be resold to the dealer at slightly less than the original cost, so there is no waste. Silver of gauge 23 (British standard gauge), ·024 in. thick, is stout enough for the articles illustrated by Figs. 47 to 53, with the exception of the butterfly design, which should be gauge 18 (·048 in. thick).

Fig. 47 is a design for a border for a pierced photo frame, a quarter of the pattern being given. It could conveniently measure about 4 in. by 3 in.

Fig. 48 is a design for a pierced brooch that should appeal to the beginner on account of its extreme simplicity; it is enriched with a mounted stone in the centre, turquoise for preference, that is fitted to a narrow rim of metal soldered to the fretted work, the stone being kept in place by burnishing the rim over it.

Fig. 49 is intended for a waistbelt clasp, which would be productive of a very dainty effect if nicely pierced in metal of sufficient thickness to afford rigidity. The hook for uniting the two halves of the buckle is made by cutting a strip of metal the length of the buckle at the junction at the centre, and about $\frac{3}{8}$ in. in thickness. Solder this strip at right angles to one of the sections, as near the edge as practicable, as shown in section in Fig. 50, to form the hook shown in Fig. 51. The loop for the opposite half is bent from wire, and, in soldering it in position due care must be taken that, when hooked, the front faces of the clasp are properly brought together.

Fig. 52 shows a small hair-comb of simple design, the fretted upper part being soldered to a rim that encircles the comb, and which is secured thereto by two or three minute rivets.

The pendant (Fig. 53) will need the delicate execution of a practised hand.

Coming now to the actual execution of the piercing, the first consideration is the transferring of the pattern to the silver. Expert workers usually scratch the pattern on to the metal with a fine point; but this method has its disadvantages with a beginner as a deep scratch incorrectly made requires a good deal of polishing to efface completely, and results in a thinning of the metal. The best and safest method undoubtedly is to trace out the pattern, and paste it on the metal. Tastes differ with regard to the best form of drill to employ for the work. Some workers prefer an archimedean drill stock, working a very fine twist drill, others an ordinary piercer set in a wooden handle, and this latter the writer has always found more serviceable and quicker. The metal during the drilling is laid flat on a block of lead or hard wood. The fine twist drills, being so highly tempered, will be found very delicate, and therefore only slight pressure must be put upon them; they should be lubricated with turpentine. Having drilled all the interstices for threading the saw—bearing in mind remarks on this point given on an earlier page—the cutting may be proceeded with. Select No. 00 saw blades, and use them gently. Before clamping one in the frame hold it up to the light so as to set the teeth pointing downwards. It is far better to take plenty of time and get a true outline than to hurry the work and to rely on the files. Oil the saw occasionally or it will be liable to get hot and snap. Tradesmen keep at hand a piece of beeswax and occasionally draw the saw through it, this making the work much easier. Upon completion, remove the paper from the face of the metal, and then make any necessary amendments. A fine round needle file will be found invaluable for truing the curved parts, for it is hardly likely that the cutting cannot be improved upon; a three-cornered file answers best for the sharp angles, the parts that offer the greatest difficulty in small work.

Now lay the silver on a piece of board, and scrub it well with a cork, pumice powder and water, to remove the "tinny" look of the freshly sawn edges, and to improve generally the appearance of the work; finally polish with tripoli and oil.

In two of the designs, that of the comb and pendant (see Figs. 52 and 53), it will be noticed that a few marks are added that give greater expression to the forms. This is known as "chasing," which, in the present instance, merely resolves itself into a few careful scratches, that should offer no difficulty, provided the work is held perfectly steady during the process, such as by securing on a repoussé worker's pitch-block; then with the chaser and small hammer the few lines requisite are carefully indented.

When working in silver and gold, there should be a receptacle—a chamois leather bag or a pan—underneath the cutting board to catch the saw-dust and scrap, known in the trade as "lemmel."

Lamp - shades.—For such a purpose as a lamp-shade that comes constantly before the eye, pleasing design and good construction are an absolute necessity. Fig. 54 shows a design which for general purposes is sufficiently elaborate. It will be best to make a rough shade in paper and to experiment until the shape of the shade harmonises with the form of the base. Such shades would be most suitably made of cold-rolled copper, planished and pierced.

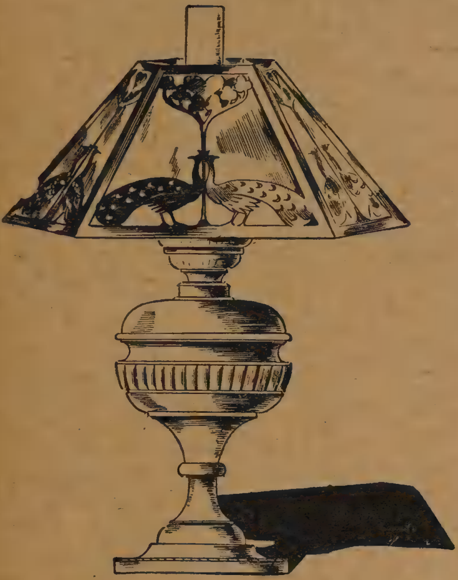


Fig. 54.—Lamp-shade in Pierced Copper

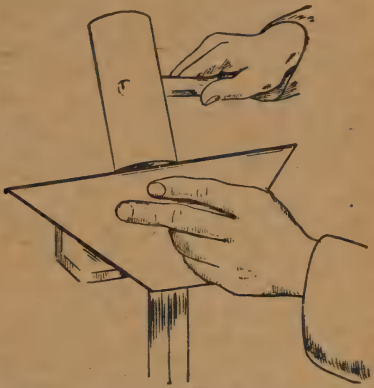


Fig. 57.—Preparing Edge of Lamp-shade for Wiring

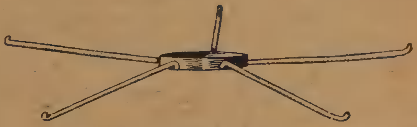


Fig. 58.—Lamp-shade Support

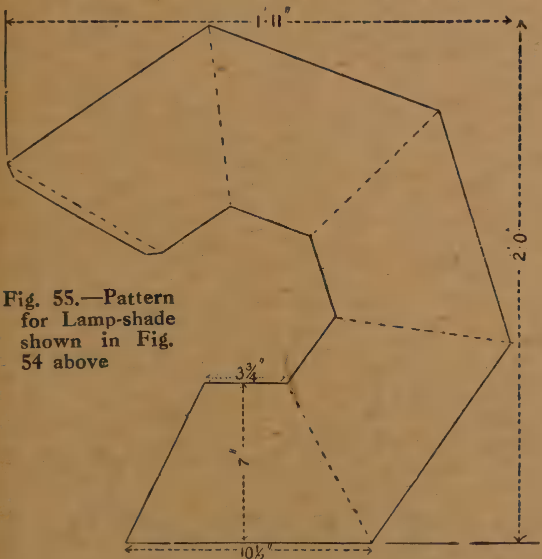


Fig. 55.—Pattern for Lamp-shade shown in Fig. 54 above

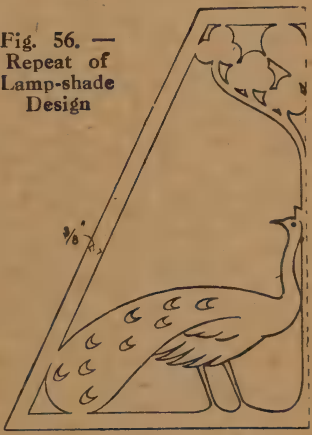


Fig. 56. — Repeat of Lamp-shade Design

The sawing is done with a metal fretsaw having a frame with at least a 5-in. sweep. When all the open parts have been removed, the work is smoothed up with a file to remove jagged edges and to true the corners.

The pattern for the shade shown by Fig. 54 is given by Fig. 55. The design for piercing is shown in Fig. 56, this being repeated in reverse in each section. The entire shade may be sawn out of one sheet of metal if desired, and, after piercing, bent to shape. A piece of metal measuring, roughly, 2 ft. square, will be necessary. If sawn from one piece a wired edge is scarcely necessary, although it gives a finish to the work; but a small margin ($\frac{1}{16}$ in. would be sufficient) should be allowed for turning up, both at the top and bottom if the edges are not wired.

For wiring the edges of the lamp-shade, should this be thought necessary, first scribe lines $\frac{5}{32}$ in. from the bottom edge in each case, and this amount is turned over by striking along the edge of the metal over a hatchet stake to produce a curve, the hollow of which is approximately that of the wire. Fig. 57 shows the process. Insert the wire into the hollow, and with the flat end of the paning hammer close the fold by tucking the edge of the metal close under the wire.

With regard to the support for the shade there are many on the market that could be adapted for the purpose; but the simple device shown in Fig. 58 serves the purpose. It may be attached to the shade, or the latter may merely rest on it. The supporting wires should be hard-soldered to the metal ring.

The shade linings may be white translucent glass, or coloured cloth stretched on a separate wire frame may be employed, or the shades may be lined with both wire gauze and cloth. The gauze is soldered to the inside of the shade, and the cloth inserted stretched upon the wire frame.

Preventing the Rusting of Tools

THE potassium bichromate treatment has been strongly recommended as a preventive of rust. Its action is obscure, and has not yet been satisfactorily explained. The treatment is very simple. Obtain some potassium bichromate (a shilling's worth will be sufficient for 1 gal. of solution) and some sodium hydroxide (lye). To 1 gal. of distilled water, warm or hot if possible, add about one or two tablespoonfuls of the hydroxide (lye), and after it is dissolved add the bichromate. Make the solution saturated —that is, put in as much of the bichromate as will dissolve. Since the crystals do not dissolve very fast, the solution should be stirred.

Clean the tools, etc., to be treated, and smooth and polish them, if possible, with glasspaper, emery-paper, or emery-cloth. Then immerse the tools in the solution. When several pieces are treated at the same time they should not touch or interfere with one another. The treatment should last as long as possible—one, two, or more days, or even for several weeks. The tools may be taken out and used as needed, and then re-immersed in the solution, care being taken to keep them clean or to re-clean them. Some tools, as screwdrivers, squares, dividers, etc., can be left in the solution continually day in and day out, and be taken from the solution as needed, this method keeping them bright indefinitely. If the solution evaporates or, instead, gets weak, more water or bichromate and lye may be added as needed.

Ordinary tools can be washed and wiped with a cloth after treatment without destroying the non-rusting effect.

This treatment does not injure the tool in any way, and is applicable to fine tools as well as the common ones. The protective effect wears off in time if treatment is not repeated.

Warming Two or More Rooms From One Grate

WHILE it must not be expected that two or more rooms can be warmed with the amount of fuel usually devoted to one room, yet it is possible to convey heat from one fire grate to other rooms, and warm them at an expenditure for fuel well under what it would cost if there were separate fires in each room. There is, too, an agreeable saving in attention and grate cleaning when the method of warming described in this chapter is adopted.

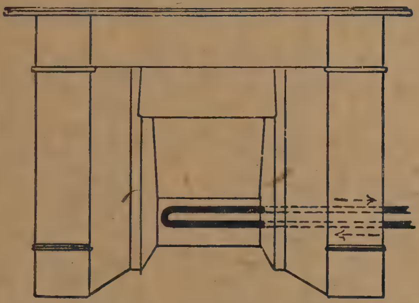


Fig 1.—Horizontal Tube Coil at Back of Grate

The method is to put a water heater of some kind (it cannot always be called a boiler) at the back of the grate fire, this heater having circulating pipes extending from it to a radiator or radiators in another or other rooms. (Sometimes a radiator is put at another part of the same room, the latter being too large to be heated properly by the fire grate, which may be at one end of it.)

Fig. 1 shows the most simple arrangement possible, this consisting of a piece of 1-in. or 1¼-in. wrought tube, bent C-shape and resting horizontally against the brick that forms the back of the firebox, as shown. From this the pipe ends are continued as flow and return to the radiator. This simple and low-power heater cannot serve more than a rather limited area of radiation, and it must be considered that one square (superficial) foot of surface on the heater (boiler) will not serve more than 30 sq. ft. of heat-losing (radiating) surface. If the tube at the back of the fire should be 1 in., and 2 ft. 6 in. total length, then it would have ·85 sq. ft. of surface and be capable (with a suitable fire) of serving 25½ sq. ft. of radiation. The last-mentioned word means any heat-losing surface, usually part radiator and part exposed circulating pipes.

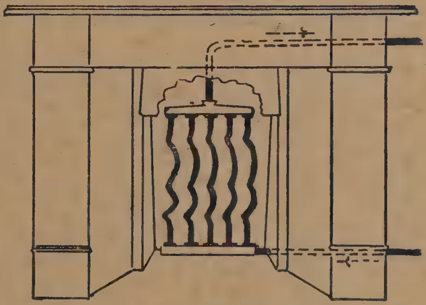


Fig. 2.—Prior's Tubular Heater at Back of Grate

Sometimes, three pipes can be arranged for, in which case the flow goes out at one side of the grate, and the return comes in at the other; occasionally, four pipes are possible. Larger pipes—though 1¼ in. is usually the largest—having more surface, will do more work. Any pipe table will give the surface areas of pipes of different diameters, but the two common sizes are given here:

Internal diameter of pipe: inches	*Square feet of external surface per foot run or lineal foot*	*To convert lineal feet to square feet, multiply by*	*To find square feet of surface required in lineal feet multiply by*
1	·334	·334	2·994
1¼	·434	·434	2·3

Occasionally, this method of heating is adopted for the pipes in a conservatory adjoining a room which has a fire regularly in it; but it has to be remembered that the grate fire may be out from 11 p.m. to 7 a.m., and at 3 to 5 a.m., when the cold is most severe, the water in the conservatory pipes will be quite cold. Unless a low fire can be kept all night, or nearly all the night, this arrangement must be fatal to any but very hardy plants.

There is quite a number of heaters and boilers designed expressly to go at the backs of grate fires to heat radiators or hot-water pipes in other rooms, but little would be gained by describing these in detail. Ingenuity is devoted to making these heaters as effectual as possible, but most of them make it necessary to have either a new back to the grate or a new grate entirely. One heater, however, may be mentioned here—" Prior's Heat-distributor "—illustrated by Fig. 2. This does not make any great alteration to the fire-box necessary, provided there already exists a modern back to the fire, a back consisting of a fire brick slab either upright or preferably leaning forward—overhanging the fire. The heater stands upright against the back brick as the illustration is intended to show; and it consists of a horizontal tube at top and bottom, extending between which there are copper tubes of quite flat section, zigzagged, something as shown, so as to present the greatest possible surface to the fire. It should be mentioned that the flat copper tubes present their edges—the thin part—to the view, so that they are not so conspicuous as might be thought. These are, of course, of greater efficacy than the simple horizontal tube coil shown in Fig. 1, the writer having seen one of 5-tube size (as illustrated) heating 80 sq. ft. of radiation, and keeping it at 160° with quite a moderate fire, not specially stoked or forced.

Finally, there remains to be explained what perhaps is the most vital detail in fixing any kind of water-heater at the back of a grate fire. This is particularly the case with pipe as bulky as 1¼-in. size, or with any kind of boiler. It is still important, though less so, with 1-in. pipe, or thin tubes like the Prior heater. The detail in point is that the fire-box must be deep enough from front to back, because the water pipes or surfaces may have too great a deadening effect on a thin fire. Probably, the width of the fire-box cannot be altered; but the depth must be altered if found necessary, as otherwise the work will result in failure more or less. The fire or fuel must be in sufficient bulk to burn freely notwithstanding the cold or cool water surface in or against it; and this is where it will be found that two rooms cannot be warmed with the same fire and fuel consumption that does for one room.

It should be seen that the depth of fire, front to back, is never less than 6 in. from inside the front bars to the front of the pipes. This would make the fire-box to about 7½ in. from inside the front bars to the face of the back brick. This should be the minimum and may be exceeded a little without entailing extravagance of fuel. Within certain limits a deep fire burns no more fuel than a shallow one, as it may be allowed to burn more slowly and not need to have the fuel stirred or the bottom cleared so often.

Electro-plating

To be successful in all forms of electro-plating, absolute cleanliness is essential. Many of the troubles encountered by the amateur plater are caused solely by dirt; and nothing should ever be allowed to interfere with a rigorous application of the principle of cleanliness to every action and each process.

THE SOURCE OF ELECTRIC CURRENT

The Dynamo.—The first question to decide is how the current required is to be generated. Where the output of work is not large, there can be no doubt that the battery is better than the dynamo.

Of course, where large quantities of work have to be done, there is no question as to the dynamo being the cheaper to work. It should always be placed in a corner by itself, and a partition carried up to the ceiling all round to keep dust, chemical fumes, and liquids from getting to it, and to prevent oil and grease splashing from it; for on no account should grease or oil be allowed in any depositing room. For this reason it is as well to have water, soap, and towel in a corner of this partitioned space for washing the hands immediately after handling any part of the dynamo or machinery.

One of the great mistakes made by many in the past has been in yoking the dynamo to steam-power that also runs several other machines, such as for polishing or grinding. Now, when much heavy work of this character is begun or finished during the running of the dynamo, it is impossible for it to keep a uniform speed. This is absolutely essential to the success of electro-plating by this means, for a "jumpy" current, sometimes high and sometimes low in intensity, is not suitable; it must be regular and uniform. This being so adds to the difficulty of using a dynamo, and also to its cost, for unless the workshop engine is capable of running at a uniform speed, it is best to have a small oil-engine or gas-engine to drive it alone. Good results are difficult to obtain under other conditions, and where very heavy deposits are required batteries are out of the question. An essential requisite with a dynamo is a resistance board, and for successful results it is necessary that there should be one to each vat. The coupling of two or three large vats together is a mistake, and makes individual regulation of the current impossible. An outlay on this score will soon repay itself in the prevention of spoiled work.

Batteries.—Where the work consists principally of gilding or silvering, the primary battery is the general means of producing current, and for even good qualities of nickelling or brassing it gives very satisfactory results. There are several kinds that are suitable—the Grove, the Daniell, the Wollaston, and the Bunsen.

The Bunsen Battery.—This (Fig. 1) is the most reliable and useful for ordinary work. It comprises a stoneware jar, of suitable capacity, containing (1) a cylinder of sheet zinc, and (2) a porous pot in which stands a carbon block. There are thus an outer and an inner vessel, in each of which is a liquid (the "electrolyte"); in the former, between stoneware jar and porous pot, is a mixture of 1 part of sulphuric acid and 12 parts of water; in the latter is strong nitric acid. Always add the acid to the water (not the water to the acid, for this is dangerous), stirring with a stick the while. Put in so much as will nearly fill it when the other elements are added. These are, first, a sheet of zinc bent almost cylindrical in shape. These cylinders can be purchased ready made, and only require amalgamating with mercury before inserting in the acid. This is a necessary, but rather troublesome job, especially if the mercury is not plentiful. The best way is to immerse the zinc in the dilute sulphuric acid and pour the mercury on it, rubbing it over with a piece of rag tied round the end of a stick. It will adhere fairly closely, and must be made to completely cover the cylinder inside and out. It is best to have plenty of the mercury, for that which is not wanted for amalgamating should be poured into the outer cell to cover the bottom of the zinc and protect it from the acid. If, after each occasion of use, the zincs are taken out and inverted, they will keep well covered all the time. If the zincs are not kept well covered with mercury, "local action" sets up and destroys them.

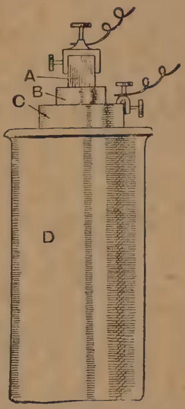


Fig. 1.—Elevation of Large Bunsen Cell

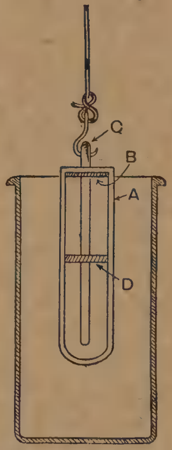


Fig. 2.—Section of Wollaston Battery

Inside the zinc cylinder a porous pot of a special make of earthenware is next placed. This is first filled with strong nitric acid, sufficient to bring it to the same level as the outside sulphuric acid solution when the solid carbon block is inserted. To this carbon block and to the zinc cylinder binding screws to hold the ends of the wires are attached, and the battery is then ready for work. In Fig. 1, A is the carbon, B the porous pot, C the zinc cylinder, and D the outer vessel.

The Wollaston Battery.—Where only small quantities of work are contemplated, it is as well to use the Wollaston battery, as being more economical and easier to regulate. At its best it is never so strong as the Bunsen, which is one of the most powerful of batteries; but it is quite strong enough for gilding and silvering in even moderately good quantities. A section of this battery is shown by Fig. 2.

In this battery the "couple," as it is termed, is copper and zinc, instead of the zinc and carbon of the Bunsen battery. Diluted sulphuric acid (1 in 12, as before) is put into a stoneware jar, preferably of an oblong shape. Then a piece of sheet copper, nearly as wide as the jar, is bent to shape as shown at A (Fig. 2), and the ends secured with strips of the same metal, which are fastened over a piece of wood B long enough to rest on each side of the jar. In this piece of wood a slot must first be cut wide enough to take a stout sheet of zinc C of nearly equal width to the copper. A piece of wood D, having a similar slot, must be fastened half-way between the sheets of copper, to prevent the zinc touching it. This zinc plate must be first well amalgamated, and if, when in use, the plate gives off a hissing noise, re-amalgamation of the zinc becomes necessary. The slot in each piece of wood must be large enough to allow for the free movement of the zinc, for that is part of the usefulness of this battery. Immediately above where it is to be fixed, fit a pulley wheel with a cord through it, with a weight attached at one end. The other end of the cord is secured to the zinc, and it can then be raised or lowered as desired, to decrease or increase the intensity of the current as desired.

The batteries are best kept out of the plating shop, their proper place being a well-ventilated outhouse where there is a plentiful supply of water. Another thing best outside is the drying-out tin, for the dust is bad for every person and every other process employed.

Small Batteries.—Cells of the type above described work best if made of ample size, but there is no reason why the amateur with only a small amount of work to do should not use a much smaller cell. The pushing force (" voltage " or " electromotive-force ") remains the same whatever be the size of the cell (nearly 2 volts in the Bunsen, and not much more than 1 volt in the Wollaston), but the volume of current is not so large, of course, in the smaller cell.

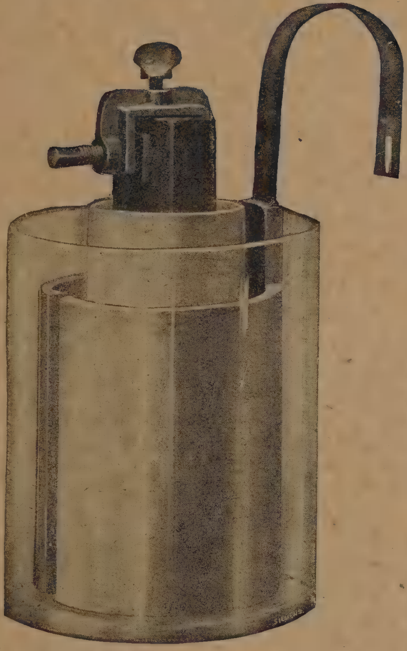


Fig. 3.—Small Bunsen Cell

For small plating jobs, a shop-bought Bunsen (Fig. 3) or Daniell (Fig. 4), of either one- or two-pint size answers very well. The Daniell is a remarkably constant cell, and very many varieties of it are in use. The simplest (known commercially as the " Original Daniell ") comprises a round glass jar (see Fig. 4) containing a porous pot. Surrounding the pot is a copper cylinder ; inside it is an amalgamated zinc rod. In the outer vessel is a saturated solution of copper sulphate (that is, the liquid cannot take any more of the sulphate into solution because all its pores are already occupied with that already dissolved) and in the porous pot is sulphate of zinc solution, sulphate of magnesium solution, or dilute sulphuric acid, the liquid being poured in to form a higher level than that of the copper sulphate solution outside. The cell is kept in condition by adding occasionally a few crystals of copper sulphate to the outer vessel and replacing a part of the solution in the inner one with distilled water or filtered rainwater. In use, the zinc rod is used up and requires to be renewed, and the copper cylinder becomes thicker and needs to be replaced with a thinner one. If used for constant work on a circuit of high resistance, the cell remains in order for several weeks, the actual period depending on the size of cell. The electromotive-force is only just over 1 volt, and there is not much volume of current avail-

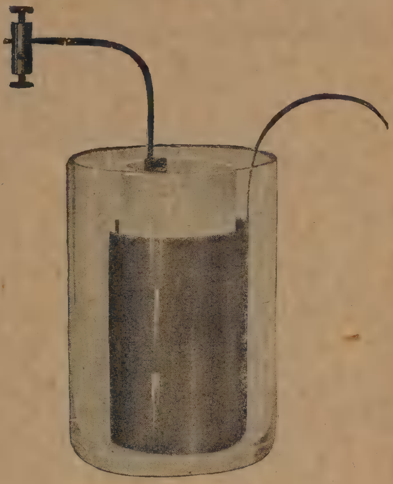


Fig. 4.—Daniell Cell

able, but it has the compensating advantage of constant voltage and long life between the chargings with the chemicals.

The invention of the Daniell cell embraced that of the principle of electroplating, as will now be explained.

Principle of the Electro-plating Process.—The technicalities of electrodeposition of metal will not be entered into here, but a simple explanation of the process must be given. Imagine two metal plates standing in a vessel of water, and that the positive pole of a battery is connected to one and the negative pole to the other. When current passes, the water will be split up into its component parts ; where the current enters the water (at the positive plate) oxygen will collect, and where it leaves the water (at the negative plate) to return to the battery, hydrogen will form. If the place of the water is taken by a suitable solution of metal, the hydrogen as formed enters into certain chemical combinations, and the metal is separated out and thrown upon or deposited upon the negative plate. The positive plate is the *anode*, and the negative plate the *cathode*. Further, if the anode consists of the same kind of metal as is being deposited, and if the solution is of a suitable nature, as fast as the metal is deposited on the cathode the solution takes a further supply of the metal from the anode, the result being that in time the cathode or negative plate becomes much thicker and the anode or positive plate disappears. The Daniell cell, already mentioned and illustrated on the preceding page, affords in its working an illustration of this principle.

The essentials, then, are a source of electric current ; a solution of the metal that is to be deposited ; and a rod to lead in the current, and one to take it out again. The first rod is the anode, while the articles to be plated, electrically and mechanically attached to the second rod, form the cathode. If the anode is insoluble in the solution it merely leads in the current, but if it is soluble it replenishes the solution in addition to leading in the current.

GOLD-PLATING

The Gilding Solution.—The gilding solution is generally made with double cyanide of gold and potassium. For each gallon of solution take 8 dwt. of fine gold, and convert it into gold chloride by dissolving it in a mixture of equal parts of nitric and muriatic acids (or use gold chloride bought already prepared). Place the porcelain dish containing the solution on an iron dish filled with sand and heated underneath by a gas flame or fire. Evaporation to dryness will leave a small quantity of gold chloride, and this should be dissolved in 1 pt. of distilled water and allowed to stand for a short time in case the gold was impure, when the baser metal will be precipitated. Then pour the clear liquor off into a clean vessel. In a separate vessel dissolve 1 oz. of the purest potassium cyanide in 1 pt. of water. Add this gently to the gold chloride, gradually stirring the while with a glass rod or wooden stick free from resin. A brownish-looking precipitate falls to the bottom of the vessel, and care must be taken not to add any more cyanide than will throw down all the gold. This must be allowed to settle, and when precipitation appears to have ceased, pour off the clear liquor and treat it separately with more cyanide to see that no gold is wasted. The precipitate is now washed in clear water, and afterwards more potassium cyanide solution is poured in to dissolve it, after which the quantity is made up with distilled water to its proper quantity, in this case 1 gal. This solution is best worked at a temperature of 145° F.

It is not usual to work gold solutions cold because it is difficult to get a good gold colour with them. But with this solution the colour can be varied down from rich gold, at the temperature just mentioned, to a pale straw or lemon colour at 60° F., so that when a large number of articles are required to be of a uniform colour, it is necessary to keep the temperature uniform, and an equal surface of anode immersed in the solution. All evaporation must be made good by distilled water.

Where a lot of work is done day by day and good effects are desired continually, it is more economical to use two baths. Into the first bath the articles are placed for only a very few minutes, or even seconds for a very thin coat, after which they are at once transferred to the other bath for completion. The results justify the method in long life to the bath, uniform finish, and saving in materials.

Getting the Battery Ready.—Having prepared the bath, the next thing to do is to get the battery ready. The zinc cylinder of a Bunsen battery, after standing all night, should be put into the outer cell, the reverse end up. Then the mercury that has settled at the bottom will be able to again pass downwards, amalgamating the zinc as it goes. In fact, whenever anything is done to one of these zincs, make it a rule to reverse it, and the troublesome job of amalgamation is then not so often necessary. It must not on any account be neglected when required, for " local action " not only impairs the efficiency of the battery, but shortens the life of the zinc. However, for small operations, and especially for small gilding jobs, the Wollaston or the Daniell battery is to be preferred. They are not only regulated more easily, but, not being so powerful as the other, there is less liability to " burn " things in the bath. Clean the wire terminals every time of use, and have all ready before the articles are hung in the bath.

Preparing Work for Gilding.—The preparation of the articles for the bath is varied to suit the different processes they have previously been through. For instance, in gilding jewellery, most of it has been through the fire for soldering, so that little grease is left upon it, in which case, after pickling in weak nitric acid (say 1 part to 12, 16, or even 25 parts of water), to clear off the scale, they are scratch-brushed (scoured with a brass-wire brush), dipped in potassium cyanide solution ($\frac{1}{2}$ lb. to $1\frac{1}{2}$ gal. of water), rinsed and placed in the bath. If there is the slightest trace of grease about them, they must be dipped in caustic potash solution (1 lb. to 2 gal. of water) kept quite hot—nearly boiling, in fact. An ordinary iron pail or a gas ring answers the purpose splendidly. It may sometimes happen that the potash turns the colour, in which case the articles must be scratch-brushed all over and passed through the cyanide.

Hands and arms must be kept out of this " boil "—as it is generally called, whether hot or cold—for the potash has an injurious effect on the skin, and nasty sores, difficult to cure, often arise through carelessness in this way. Therefore all articles should be wired, so that they can be easily dipped into the various mixtures, as well as for suspending in the bath. It is well to use a fairly substantial copper wire for this purpose, suitable lengths being bent at each end (see Fig. 5), so that they can be used many times. The gold which accumulates on the ends can then be " stripped " off when necessary, and waste is avoided. For articles such as spoons, having no holes or loops, use thinner and longer wire (see Fig. 6).

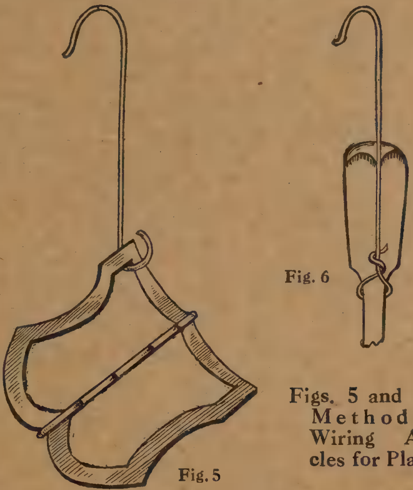


Fig. 5

Fig. 6

Figs. 5 and 6.—Method of Wiring Articles for Plating

Articles made of silver, brass, or copper readily take the gold deposit ; but iron, steel, or britannia metal is best electro-brassed first, and this forms a very good foundation for the precious metal. For small jobs in iron or steel it has been found sufficient to dip them in weak hydrochloric or sulphuric acid pickle, and scratch-brush them direct, when, a voltaic action being set up, by the acid, between the copper in the wire brush and the iron or steel, a bright film of the former metal is put on the articles, sufficient to form a good basis for the gold.

In gilding german silver there is danger of a mushroom deposit, which easily comes off, if the electric current is applied immediately the articles are placed in the bath. Therefore, it is best to give them a few minutes without any current, when they become coated slightly by mere simple immersion. When the current is applied, only a small surface of anode is immersed and the bath should be worked at a lower temperature. It is as well to use a separate solution for this work, one much weaker both as regards the gold and cyanide.

The Electrical Connections.—When the articles are in the bath, the rod bearing the articles forming the *cathode* is attached to the wire connected to the zinc in the battery, and the rod bearing the *anode* to the wire connected with the positive pole of the source of current—the copper of the Wollaston battery, or the carbon of a Bunsen battery. To get an even deposit it is well to keep the articles moving, and to keep a watchful eye on them. The best anode for the purpose is one of platinum, which, though expensive to start with, is cheaper in the end, being much more durable than a gold one, and giving as good results. Of course, a gold anode is soluble and replenishes the solution, but when it is nearly worn out it is liable to fall apart and to be wasted. With a platinum anode, which is practically insoluble, the gold deposited is of a better commercial colour. The use of a silver anode produces a much lighter deposit.

Gilding Insides of Vessels.—Many silver and plated articles such as cream jugs, egg-cups, etc., require gilding only on the inside. These are first scratched inside with an end brush of wire, then after rinsing placed on a level board or table, and gold solution is poured in, sufficient to cover all the parts required to be gilt. The wire from the negative pole of the battery is then attached to the vessel itself, and the wire from the positive pole fastened to the anode, which is gently lowered a little way into the solution inside (see Fig. 7). On no account must it ever touch the vessel; but if suspended properly, a few minutes will suffice to put a fair coating where required.

The inside of spoons or spouts of ewers can be done in a similar manner, only the anode, which for this purpose may be the end of the wire (but, of course, better still a strip of platinum or gold), is wrapped round a piece of clean rag, and, after dipping in the solution, is rubbed gently over the parts (see Fig. 8). Great care must be taken that the solution does not run over the other parts.

Frosted Gilding.—A dead or frosted colour can be got on brass or copper articles by first dipping in a solution of equal parts of nitric acid and oil of vitriol, to each quart of which has been added a spoonful of salt. Dip only for an instant, and plunge at once into clear water, afterwards transferring to the gold bath.

Ormolu Gilding.—The beautiful effect called ormolu is produced by first gilding well and afterwards scratching thoroughly. Then make up a mixture of equal parts of alum, saltpetre, and oxide of iron (all of which must be in fine powder) into a paste with a solution of annatto. With this coat the article, and allow to stand for a few moments, afterwards washing off in water containing the same constituents in solution. When the proper colour is obtained, wash off in clear water and dry. This colour is not always easy to get at a single operation, and it is sometimes necessary to remove the colouring by dipping in sulphuric acid solution and repeating the process.

Colouring Gold.—Articles of inferior gold are sometimes gilded to give them a good colour. There is also another way of doing this without gilding, which may be mentioned here. A solution consisting of 2 oz. saltpetre, ½ oz. each alum and common salt, and a little hot water is made, and very slowly heated, stirring with a wooden spoon or glass rod until it begins to bubble. Dip the work for a few minutes according to bulk and weight, then withdraw and plunge into hot water. If not satisfactory, immerse again; for although at first the article turns quite black, it soon comes to a beautiful gold colour; but it may be necessary to dip several times to obtain this. Rinse in clear water, and dry in hot boxwood sawdust.

Stripping Gold.—When it is desired to strip gold from articles, such as the wires used for slinging, they are generally dipped into a solution of 4 parts of hydrochloric acid to 1 part of nitric acid. This operation requires attention, for the acid is very active; immediately the gold is removed, plunge into clear water and dry out. This process can also be performed by the battery, if the articles are hung on the cathode rod of the plating vat; but this is a method not often used, as it is so much slower than the other.

In a later chapter will be found instructions on gold-plating without the help of a battery.

SILVER-PLATING

The Solution.—An ordinary electroplating solution for silver is prepared by dissolving 2 oz. of grain silver of fine quality in a mixture of 4 oz. of nitric acid and 2 oz. of distilled water in a porcelain saucer. Avoid the fumes, and when the action begins to cease, place the saucer on a warm sand bath (that is, a small tin filled with silver sand placed over a small gas flame or elsewhere to get hot). Leave until all the acid is evaporated and crystals of nitrate of silver remain. Dissolve these in 2 qt. of water contained in an earthenware pan, and afterwards pour in a strong solution of potassium cyanide, made as before described. A precipitate of silver cyanide will fall to the bottom of the vessel. Stir well with a glass rod or stick, and add the cyanide gently until the whole has been precipitated. Be careful not to add too much cyanide; but after pouring off the clear liquor, try it again with a little cyanide to see if more silver falls. The whole of the precipitate should then be placed in a vessel full of clear water and well stirred, after which let it settle to the bottom again. This may have to be repeated with more water until the silver is well washed. Afterwards place it in the vessel again, and this time pour in a strong solution of potassium cyanide, which soon dissolves it. Do not, however, add more at the time than will dissolve the silver, so that the amount of added cyanide can be guessed easily. This should be about a quarter of the quantity used in the dissolution and is added to form cyanide, which, if in too great an excess, is not beneficial to the bath. Then add water sufficient to make 1 gal. Silver anodes should be used with this bath.

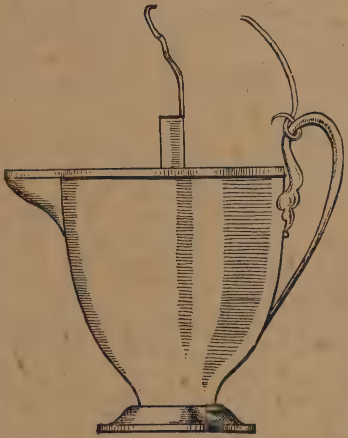


Fig. 7.—Plating Inside of Cream Jug

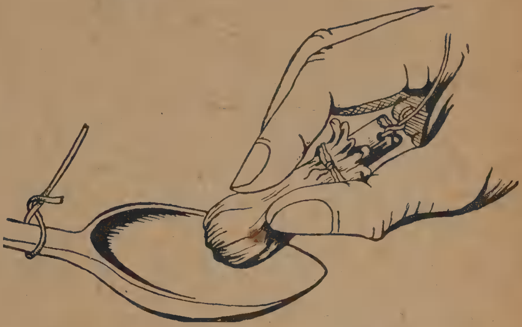


Fig. 8.—Plating Inside of Spoon

Work plated with this solution leaves it with a "bloom," the usual grey misty finish, and has to be improved by scratch-brushing all over, which, if properly done, rapidly brings up the proper silver colour.

A solution that plates bright may be made by adding benzole dissolved in strong cyanide to an ordinary bath as first described. A teaspoonful to every 10 gal. is said to be sufficient; but the amateur is strongly advised to leave "bright plating" alone; more solutions have been destroyed by treating them in this way than from any other cause, and the gain, even if successful, is not much.

Sometimes new silver baths work in a very erratic way (an old one always works better than a new one); the anodes turn dark, and the work comes out streaky and discoloured. In such a case, add a little ammonia to correct the acidity. Always be extremely cautious in adding anything to a bath, and add only a very little at a time; addition can be made much more easily than subtraction.

Preparing Work for Silvering.—Ordinary articles are cleaned in the boiling potash solution already mentioned, brass and copper articles being afterwards passed first through clear water, to rid them of potash, and then a weak potassium cyanide solution, rinsed in clear water, and transferred to the bath. If very dirty or greasy, scrubbing with a mop, dolly, or brush made of cotton waste instead of bristles, and some silver sand will be necessary. These brushes (see Fig. 9) can be made quite easily with some soft copper wire, by placing an old back in a vice and drawing through enough cotton waste to plug tightly the holes. The same wooden back can be used time after time, and the worker can arrange the cotton waste as required.

Iron and steel require to be coppered or brassed before silvering; the merest film is sufficient, but after receiving it the articles must be immediately transferred to the silver solution. It is possible to do without the coating of copper or brass if a special bath is used for giving a preliminary coating of silver. This consists of 1 oz. of silver converted to nitrate as before, and afterwards dissolved in potassium cyanide, as described previously; but the quantity of cyanide to the gallon is made up to 2 lb., giving a solution weaker in silver but strong in cyanide. A copper anode should be used. The film of silver deposited is not of a good colour, but it is a firm foundation for finishing in the other bath. The recipe first given would be a suitable solution for this work after "striking" as just recommended; but in any case, a bath that contains more silver or cyanide is quite unsuited for this work. One-volt electric pressure is ample to a moderate size vat full of work; but this is subject to many other considerations, and only experience can exactly tell what to do in this way.

It is well to keep iron and steel articles moving when plating, or they may be streaky and of a bad colour. The preparation of these metals is different from that of brass or copper, requiring instead of a cyanide dip one made of 1 gal. of water and 1 pt. of muriatic acid, and the usual rinsing in clean water; otherwise the process of cleaning is similar.

"Quicking" Solutions.—Britannia metal is usually "quicked" if the ordinary bath is used for silvering. This solution is prepared by dissolving 1 oz. of red oxide of mercury in a solution of cyanide, and afterwards adding enough water to make 1 gal. A mere dip is sufficient to at once coat all over any article, which should be transferred to the silvering bath immediately. Throw away old "quicking" solutions when becoming exhausted; do not try to strengthen them.

Treatment of Various Metals.—It is possible to plate britannia metal, pewter, or german silver without a preliminary quicking if the following bath is used: Dissolve 2 oz. of grain silver as before, and convert to nitrate of silver. This, after being again dissolved in water, should be thrown down not by potassium cyanide but by potassium iodide, 3 oz. of this being dissolved in about 1½ pt. of water. Add the iodide very gently, stirring all the while, and when all precipitation is done, cover with a board and set in a dark corner to settle. Iodide being affected by light, a dark room or feeble gas or lamp light is best for all operations connected with it. Pour off the clear liquor after an hour or so, and wash well the precipitate and dissolve it in a solution of potassium cyanide, as if it were nitrate, adding free cyanide in the same proportion. Light does not then seriously affect it; but all solutions are best covered over at night or when not in use.

In ordinary solutions, german silver is almost as difficult to plate as britannia metal, but by adopting the above methods it will bring as good results as are obtained for the latter metal. However, it should be remembered that pewter and britannia metal require more silver in the bath than does german silver, and also a stronger current.

Fig. 9.—Scrubbing Brush Made of Waste

Nickel silver is almost as readily plated as copper or brass, and should receive similar treatment. Aluminium can only be plated by coating first with copper in a chloride bath, and using a silver chloride solution to follow. However, results are not very satisfactory.

Fig. 10 shows a general arrangement of the plating bath.

Finishing Work.—All work after being plated is rinsed in clear water, and then scratch-brushed to remove the frosted appearance and brighten it up. If required to be oxidised this should be done immediately after plating. Ammonium sulphide is generally used for this purpose, by mixing with a little lumbago to form a paste and brushing over the article. When dry, the parts to be relieved are scratch-brushed, and may be afterwards burnished or polished, giving a pleasing contrast.

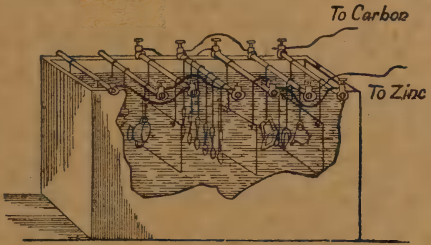


Fig. 10.—Arrangement of Bath for Silver-plating

Another good form of oxidising is by suspending the article in an air-tight wooden box, and quickly placing it over a piece of slate or tile on which is a red-hot cinder that has had a few grains of powdered sulphur sprinkled over it. In about twenty minutes the fumes will produce a fine blue colour, which is excellent as a ground for relief by scratch-brushing or polishing. A good dip for this purpose is a strong solution of sulphurated potassium, into which the work should be placed immediately after plating. The colour produced by this means is a bluish-black, and is very effectually done. Scratch-brush to relieve, rinse, and dry out, afterwards lacquering to retain the colour.

Various methods of oxidising silver plate are given on other pages.

Part Silvering and Part Gilding.—Sometimes articles require to be part silvered and part gilt. The usual process is to silver all over, and then " stop off " the parts not to be gilded; but in large objects on which the silver would be a consideration, the parts to be gilt are stopped off first, and, after silvering, the stopping-off varnish is cleaned off and the parts gilt in the usual way, after covering the silvered portions. This " stopping-off " is done with a kind of varnish, of which there are many recipes, but the following will be found as good as any, as it will withstand a boiling solution if necessary. Thoroughly melt 5 parts of clear resin, 3 parts of good beeswax, and 1½ parts of red sealing wax, into which stir well 1 part of rouge. Apply with a brush, and allow to get quite hard and set before putting into the solution for gilding or plating. It is as well to do this job in the evening, and leave until the morning to set. Potash

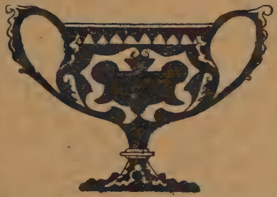


Fig. 11.—Vase Showing Pattern "Stopped off" Ready for Gilding

as used for cleaning articles, or, if preferred methylated spirit, will remove the varnish when done with. Fig. 11 shows a vase with the pattern "stopped off" for gilding.

Re-silvering.—Old electro-plated work which requires re-silvering must be stripped of all the silver remaining on it. For this purpose a stripping bath is prepared by adding a small quantity of nitrate of potash to a strong sulphuric acid solution, the latter being well stirred until the former is dissolved. The article to be dipped must not be left in this for long without being examined. As soon as the old silver begins to disappear, the article should be dipped and moved about until the stripping is sufficiently done, and not left. Then at once plunge into cold water and dry out. This bath works best if kept fairly hot. A bath for the same purpose, which may be worked cold and requires less attention, being slower in its action, is one composed of 1 part of nitric acid to 8 parts of sulphuric acid. However, in no stripping solution should articles be left long without examination, and all should be quite dry when introduced, or the water will cause the acids to violently attack the metal of which they are made.

When stripped, the work requires to be "buffed" by the polisher. Buffing is a dull, rough polish, which is given to all articles requiring to be plated, and is done with a fine emery bob or with one of plain leather and sand or pummice powder on a lathe. The finer polish is put on after the process of silver-plating.

General Precautions.—There are one or two points to remember in all plating operations, and these may be dealt with here. Never let an article in the bath touch an anode or the ends or sides of the vat, or the current will be lost. Get plenty of work in the vat before turning on the current, or the small articles will be "burned." See that all preparatory operations are performed as rapidly as is possible with efficiency, for if articles are allowed to stand about in water waiting to be put in the solution there is danger of oxidisation, which makes nugatory all the elaborate cleansing processes through which they have been, and the deposit is very likely to "strip" as a consequence. Always keep a watchful eye on work in the vat, as the best solutions go wrong sometimes, and the articles should be examined from time to time to see how the plating is progressing. The most exemplary bath cannot plate if the current goes wrong, and one never knows whether a connection has got dirty and ineffective without watching for results in the bath. Connections always require great care and attention, otherwise they are apt to cause a lot of mischief.

In a later chapter instructions on silvering by means of chemical (non-electrical) processes are given.

BRASS-PLATING

It may be as well to point out some of the causes of trouble to be met in electro-brassing. First it must be remembered that brass is an alloy, which means in this case depositing two metals at one and the same time. Furthermore, it must not be forgotten how very different are the two metals which make up brass, especially as electrically deposited. Copper, for instance, is not only more ductile than zinc, but its conductivity is much greater, and it is in consequence one of the easiest of metals to deposit, while either zinc or tin, with which it is often alloyed for electro-brassing, is much more difficult. So that to make up a bath that will deposit freely both metals under almost any ordinary conditions is not easy. However made up, it is always extremely susceptible to outside influences, especially to the weather, and for that reason it is as well perhaps to use a hot bath, as it has been noticed that there is less interference on this score where heat is used.

A good recipe, therefore, will be found in the following formula: Water 1 gal., carbonate of copper 3 oz., carbonate of zinc $\frac{3}{4}$ oz., bisulphite of soda $1\frac{1}{2}$ oz., carbonate of soda 2 oz., potassium cyanide 6 oz., and 20 per cent. liquor ammoniæ $\frac{1}{2}$ oz. First put the cyanide in half the water as above, and put the copper, zinc, and sodas in the other half; in both cases the water should be warm. When the ingredients are all dissolved, mix them together and raise to a heat of 100° F., and work as a plating bath for a short time. Then add the ammonia water, stirring briskly. This will give very good results; but if the deposited metal gets dull in colour make up a small solution by dissolving ¼ lb. of caustic soda in 1 pt. of water and ½ lb. of white arsenic in 2 pt. of water. Then mix and keep well corked in a bottle labelled "poison." Use this as a stock solution, and add a few drops to the bath when necessary.

For a cold bath the following may be found useful: Sulphate of copper 4 oz. and sulphate of zinc 5 oz., dissolved in 1 gal. of water. Then add about 30 oz. of carbonate of soda, causing a precipitate to be thrown down, which must be left to settle. When this is sufficiently done, pour off the clear liquor and afterwards wash the residue, to which, after straining, add 15 oz. of carbonate of soda and 7½ oz. of bisulphite of soda, and dissolve the whole in 1 gal. of water by briskly stirring. Finally add potassium cyanide until the liquid becomes clear, and then filter into the bath, extra cyanide being added to improve its conductivity.

One difficulty in working any brassing solution is in the fact before mentioned, that, copper having greater conductivity and being more easily deposited than zinc, the operator finds, even when a good deposit of a satisfactory colour is being obtained, that the anodes, which, of course, are of brass, become coated with a white film, beginning at first by a spotty appearance, and gradually extending all over the plate. This is a sign that all will not be right much longer unless the anodes are removed and well cleaned. The easily affected copper is being worked out, while the sluggish zinc is forming into insoluble oxide, which soon begins to hang in lumps and then fall to the bottom of the bath. The chemical constitution of the bath becomes changed by the rapid deposition of the copper, and soon the quality of the deposit becomes commercially useless by reason of its bad colour. The electro-brassing bath that will give for years really uniform results like those obtained in silvering or nickelling has yet to be discovered. Consequently, always keep a watchful eye on the anodes, and clean them frequently.

When a bath has a tendency to deposit copper alone it is well to add a small quantity of liquor ammoniæ, in addition to following the advice already given; this will dissolve the oxide of zinc, and often is all that is necessary to right the colour. At other times it may be better to add some cyanide solution of zinc; but it is always best to give the other a trial first. A solution that has been in use some time and begins to go wrong should be thrown away if it appears to need a lot of time and labour to improve it. New brassing baths, unlike silvering ones, cost little to make up, and, besides old baths do not work so well as new ones. Some operators overcome a lot of difficulty by using zinc anodes and copper ones of unequal surface, and state that by increasing first one and then the other, with care, better results can be obtained.

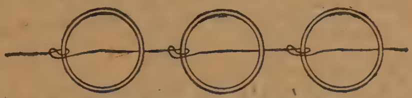


Fig. 12.—Method of Wiring Rings

Hot baths work better than cold, but they do not last so long. When working a bath warm it is very necessary to see that the container itself does not provide a short circuit for the electric current. The container must be of iron if used with a gas-ring under it, as small ones frequently are. If it is a large tank heated by steam, the same care must be exercised in regard to the steam pipes. Contact with either negative or positive rods or wire means disaster.

In preparing cast-iron work for brassing, it is necessary to look out for sandholes. These are invariably a source of trouble, because the solution and other liquids getting in are apt to cause spots on the finished goods. In the trade, articles of this class are now generally "barrelled," "rumbled," or "tumbled," by being shaken in a revolving barrel with leather "mousings" and silver sand. These after a time give a rough polish, and the holes in the iron goods, by continued knocking about, tend to close up if too deep to be removed by the polishing. Any articles that show bad holes after this treatment are picked out as unsuitable for brassing. Large quantities of iron rings are brassed, the work generally being done in barrels or baskets; but a small number can be wired as shown in Fig. 12.

The cleaning process is exactly the same as for nickelling (see a later page), but it is as well to keep a special strong potash boil for barrelled goods, as the natural oil of the leather seems to work right into the pores of the metal as it were, which is all the more deceptive by reason of its clean, smooth skin. If the last rinsing water does not stand free on such goods, put them back in the boil, and then give them a good scouring with silver sand.

Zinc articles take the deposit very well, while iron ones are much slower. For this reason it is a good plan not to have iron and zinc goods in the bath at the same time. The latter, if they have been lying by for any length of time, will require to have the dirt removed by being pickled for about a quarter of an hour in a mixture of 1 gal. of water, 3 oz. of hydrochloric acid, and 1 oz. of sulphuric acid. They should be then rinsed, and scoured with a bristle brush and silver sand until the water, which afterwards swills them, stands clear and free on them, not in patches or blisters. If not, another scouring must be given; but it is as well to avoid the potash bath if possible for this and similar metal, as the action of it is so discolouring. Grease must be removed at any cost, even if the colour has to be got back with more silver sand and brushing or other means. Hot baths plate zinc articles and those of lead, tin, or pewter better than cold ones; but a strong current is required and plenty of anode surface must be exposed, for the first few moments at any rate.

Where articles have received a good coating of brass, it is a good plan to dip them for a brief second into an ordinary dipping solution of acids, to brighten and improve the colour. This is quite a common practice, and, as brass is so cheap to deposit, it is as well to give all good work an extra heavy coating, so that it will stand this, for the acids seem to sharpen up the colour very well. Of course, only the quickest of dips and a good rinsing in clear water are necessary.

GUNMETAL-PLATING

The bath for gunmetal is generally made up as for brassing, but, instead of using the zinc salts, about half the quantity of tin chloride is used. A copper anode can be used, in which case a larger quantity of the chloride of tin can be put in. It will be found that this solution worked by one metal anode gives better results by working more evenly and causing less trouble than the brass anode. This method can be recommended from experience, and one of these solutions will with care last for some years and do good service all the time; of course, the deposit is not brass, but a good gunmetal or bronze.

COPPER-PLATING

Although electro-coppering is not so much used for certain purposes as formerly, owing largely to improved methods of nickelling and silvering, it has found many new applications due in part to the demand for bronze finishes on iron and other goods, such finishes being obtainable in many cases, only on a copper base. The deposition of copper in the process of electrotyping will be dealt with in a later chapter.

Simple Immersion Process.—Copper is one of the easiest metals to deposit, provided that proper care has been taken in the preparation of the articles. A superficial coating, such as is required in the case of certain iron goods that are to be bronzed, can be obtained by simple immersion. Dissolve 8 oz. of copper sulphate in 2 or 3 half-pints of water; also add 1 qt. of hydrochloric acid to 3 qt. of water. To the diluted acid is then added two or three teaspoonfuls of the sulphate solution, which should be kept in a bottle from which further additions to the dilute acid may be made from time to time, as may be necessary. All articles for plating by any process must be cleaned as advised later for nickel-plating. For the simple immersion process, articles of iron and steel may be wired together, if shaken occasionally when in the bath; otherwise it is better for them not to touch each other or the sides of the vessel. They soon become coated with film of reddish copper, and if taken out and lightly treated with a brass brush they will, on re-immersion, speedily attract quite a good deposit.

Articles of brass or german silver should not be placed in such a bath alone, but should be wired so as to be in contact with a piece of iron or zinc, which assists the deposition. However, if it is desired to give such articles a good tenacious coat, it will be necessary to make a special solution by dissolving 2 parts of copper sulphate and 1 part of sal-ammoniac in 15 parts of water. The articles will speedily be coated on immersing them in this solution; after withdrawing them and shaking off all superfluous liquid, they should be heated over a charcoal fire until all the sal-ammoniac is expelled, the coating of copper being now sufficient for all purposes of appearance only. Well wash the articles in hot water, and dry out in warm sawdust. For hard wear this process is of but little use, but for mere ornamentation or to provide a basis for nickelling or silvering upon, it answers very well.

Electro-coppering.—For work that must stand wear, and in cases where it is desired to coat iron, before nickelling, so as to prevent rusting when in use, it is best to deposit a good sound coat electrically from an alkaline bath. Either of the solutions given for electro-brassing earlier in this chapter may be used for the purpose, but omitting the zinc salts and adding a *further* amount of the copper salt. Pure copper anodes should be used when working all coppering solutions.

An excellent coppering bath is made as follows: Dissolve 10 oz. of copper chloride in 1 qt. of rainwater or distilled water; then add, drop by drop, liquor ammoniæ of ·880 specific gravity, stirring all the while with a stick free from resin, turpentine, grease or dirt. At first a green precipitate will be formed and drop to the bottom of the vessel. Continue to add ammoniæ, stirring well the while, until all the precipitate is re-dissolved, and the solution becomes blue; then add 3 pt. of cold water. Next prepare a solution of 1½ lb. of potassium cyanide in 5 pt. of water, and add it very slowly to the first solution, stirring gently, until the blue colour of the ammonium chloride solution has disappeared; then add all that is left of the cyanide solution. Let this solution settle down for a few hours—say, until the next morning, if possible—when it should be strained off through calico into a suitable vessel. As this bath works best at a temperature of 130° F., the vessel containing it should be an enamelled-iron vesssel with a gas-ring under it. The bath may be worked cold, but will not then be so generally satisfactory.

For small quantities of solution, such as the above, use one or two Daniell batteries, and, if necessary, the amount of the current may be regulated by adjusting the depth of the zinc element immersed in the battery solution.

DRYING FINISHED WORK

But scant mention has been made up to now of the drying out of finished goods. For this purpose sawdust from boxwood, not too fine, or, failing this, from beechwood, is the best for the purpose; and being kept in a shallow tin, should be warmed by having steam-pipes fixed under the tin. If that is not convenient, a small gas-ring can be used, as shown in Fig. 13; but this needs care and attention to prevent the sawdust from firing, as it soon will if the gas is turned too high and left for any length of time.

With gold and silver work it is best not to use anything but boxwood dust for fear of staining. A pail of hot water for rinsing after coming from the bath helps the drying-out process, and prevents stains.

After drying-out, all articles should be placed neatly and carefully in wooden trays lined with tissue paper, and not left about in a heap on the bench.

NICKEL-PLATING

Nickel-plating, of all operations in electro-deposition, is undoubtedly the most exacting and difficult. Apart from the hardness of the metal itself and its sensitiveness to the slightest disturbing influence in the course of deposition, the bath is often troublesome to get into order and to keep so. Naturally, many attempts have been made to find a reliable non-electrical method of nickelling, but so far without conspicuous success.

The Solution.—The preparation of the solution has much to do with the success of the operation. The ordinary nickel bath is made from the double salts of nickel and ammonia. The general quantity used per gallon is about $\frac{3}{4}$ lb. A very rich solution is always troublesome, and old solutions work better than new, probably because they are less strong. The salts readily dissolve in hot water, and there is no difficult process as in preparing gold or silver nitrate or chloride; but it is as well to filter through a calico strainer when passing the solution into the vat. After a solution has been got into good working order, it should be left severely alone; but when, after long use, it begins to fail, liquor ammoniæ or more of the nickel salts should be added.

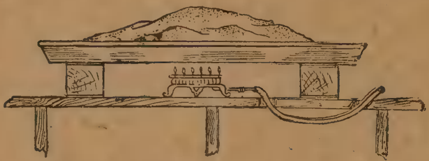


Fig. 13.—Sawdust Drying-out Tin

Anodes, etc.—The general arrangement of the bath is the same as for silver work, but the anodes require to be larger and more numerous because a nickel solution only yields its metal on powerful excitation, which can be obtained only by a good current working through the large surface of anode exposed to the bath.

It is a vexed question as to whether cast or rolled anodes are the better. One commanding advantage of the rolled anodes is their freedom from impurities, but they cost more. Whichever are used, they must be kept clean, for which purpose they must be occasionally run through the potash boil, giving them a scrub over with the brush, and then running them first through clean water, and then through a cyanide dip; after rinsing in clear water they are put back in the bath.

Nickel solutions become more quickly crystallised if dropped on any of the fittings, and it is therefore necessary to pay great attention to the contacts and to keep them clean. It is impossible to avoid splashing sometimes, and consequently it is found from time to time that articles in the bath are not doing as well as might be expected. The rods should be cleaned and the wires dipped.

Preparing Work for Plating.—Having prepared the bath, the next thing to do is to prepare the articles. For gilding or silvering, a rough polish or scratch brushing is all that is necessary, with the usual cleaning, to prepare the surface for the deposit; but with nickelling it is different. The polishing or burnishing is done on the nickelled article before it is plated. That is to say, all polishing must be done to prepare the article for the bath, not to improve it after, except for dollying and colouring up to put on a finish. Any article put in possessing a dead surface comes out the same, and polishing afterwards is so difficult that the deposit is rubbed through. Therefore, all goods go into the plating room bright, and care is taken that the subsequent cleaning does not interfere with the lustre. For this the woollen mop, dolly, or brush made of cotton waste is used; it wears better than bristles, and does not scratch the work. For very bright work, silver sand is out of the question as a scouring medium, pumice powder being the roughest that is permissible in the circumstances, unless, of course, the article is dead dipped, or in an unpolished state.

All articles require even more careful cleaning for nickelling than for any other form of deposition, by reason of the nature of the solution, which does not dissolve any slight films of oxidisation as do those solutions in which cyanide forms one of the chief ingredients. Therefore keep the potash solution boiling, and after giving the articles a good dipping in this, well scour with the dolly or brush, especially looking out for corners where grease is likely to be lodged.

Iron and steel articles afterwards require rinsing in clear water, then through a dip of ½ pt. of sulphuric acid to 1 gal. of water, and then through clear water. Hydrochloric acid in the same proportions is sometimes used for the dip; but in any case the articles, after rinsing, must be at once placed in the bath. If work is compelled to be delayed after potashing, let it stay in the first clean water, but never for more than a few minutes at the most. Never let it stand in the second water, or the deposit will be imperilled, and this applies to work on any metal.

Brass and copper goods require the same potash boil, but these metals being softer require even more careful handling with the scouring brush, as every scratch put into the metal before plating is shown afterwards. After the first rinsing in water, they must be put through a dip of cyanide (6 oz. or 8 oz. to the gallon), then through clear water again, and at once into the bath. If not required to be bright, they should be put through the dipping acid, then rinsed well and placed in the vat. This dip is composed of 1 part of nitric acid and 2 parts of water. A dip for bright lustre is made of nitric acid 1 part, hydrochloric acid 6 parts, and water 2 parts.

Tin goods do not take the deposit so well as the above, but if they are run over with a fine scratch-brush kept wet with soapsuds, a good firm deposit results. This treatment somewhat diminishes its brightness, but it saves making up a special bath for this class of work. If there is much to be done, prepare a solution containing more sulphate of ammonia, and use a brisk current.

Pewter and britannia metal are more difficult to coat with any thickness in an ordinary bath, and some platers prefer to copper or brass them first, but with a bath modified with ammonium sulphate it is not necessary to do this. However, it is as well to point out that, whatever bath is used, such articles must be briskly dealt with in all the preparatory operations, and must not wait for other work to be prepared before placing in the vat.

Small cheap work is generally done now by the "dry" process, which is of American origin. A revolving mop on a lathe is well rubbed up with crocus powder (oxide of iron) made into a composition with tallow. The work is then brightened up with this, and at once put in the vat for a short time. It will be apparent that this is unlikely to produce work of good quality.

Large articles are sometimes of such shapes and sizes as to necessitate specially shaped baths. In such a case it is important so to arrange the bath as to have plenty of anode surface round it. Nickel solutions do not so readily yield as do gold and silver solutions, and therefore require more anode surface to excite to action, and a good current to renew their metallic constituent. Large work is often difficult to clean; but it must be contrived so that the hands do not touch it after the potash boil and scouring. It is all the more necessary to keep the potash up to strength. When it becomes weak, by the addition of water to make up for evaporation, it is apt to saponify the grease on articles instead of killing it. At such times scouring is in vain, for, after rinsing, the water is seen to be in patches, which consist of soap formed by the grease and the potash; soap, like grease, is fatal to successful plating, and should not be used in any operation after potashing.

Re-plating.—Articles that have been nickelled must have every trace of nickel removed before any attempt is made to re-nickel them, for nickel cannot be deposited on nickel. For the purpose of stripping make a dip of sulphuric acid 20 parts, nitric acid 5 parts, and water 5 parts. Add the sulphuric acid to the water, stirring briskly with a piece of wood, and then add the nitric. Do not leave the article in for long, but watch closely, and if the deposit left on it is not thick it will soon be removed. It is a good plan first to give such articles a good boil in the potash, as any grease on them retards the action of the acid.

Plating Small Articles.—Articles such as ferrules, mounts, screws, etc., are generally done in quantities in a barrel which is kept revolving in the solution. Small quantities can be put in an earthenware dipping basket (see Fig. 14), and suspended from the rod over the bath, with a strong wire down to the work for conducting the current. A vigorous shake occasionally will cause the deposit to become more even, and this is essential, for as nickel does not deposit so freely as silver, a clear and open surface is best, so that it often repays the trouble of wiring separately such small goods.

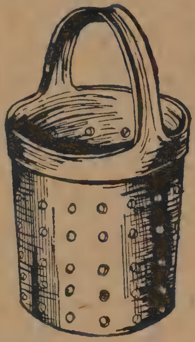


Fig. 14.—Earthenware Dipping Basket

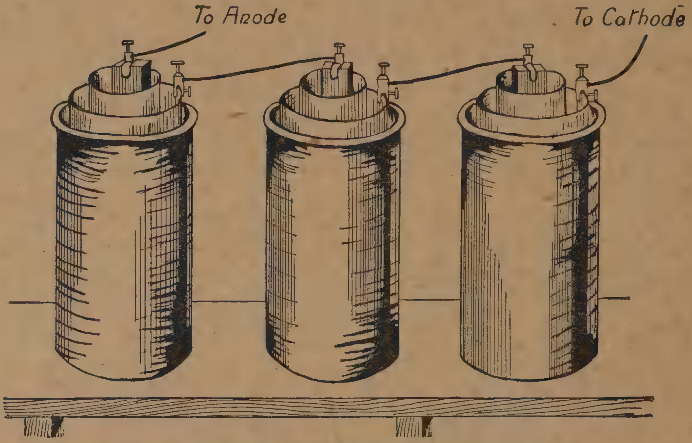


Fig. 15.—Bunsen Cells Connected in Series

For nickel-plating on a large scale a dynamo is necessary. Evenness of current which cannot so well be ensured with batteries, is indispensable. When using batteries it is sometimes found that the plating is going off in colour and speed of deposition, because the batteries are getting exhausted. If it is necessary to recharge them while work is in the bath, care must be taken not to cut off the current from all of them at once, but to overhaul them one at a time.

The Wollaston battery is quite useless for nickelling except on a very small scale, the Bunsen being the only one satisfactory. For plating large quantities of work, it is necessary to have more than one cell, and to connect the cells in series, as shown in Fig. 15.

Preparing Drawing Inks

Ordinary drawing ink is made by rubbing stick ink (China or Indian) in a saucer containing a little water. Buy the best quality stick ink and rub very lightly. This is the old-fashioned method, and draughtsmen nowadays almost always use specially prepared drawing inks (waterproof or otherwise), which are superior to those made by the above method and save much tedious work. To assist drawing ink to flow on tracing cloth, a very small proportion of oxgall may be added. For rough drawings requiring heavy masses of black, a good ink is Stephens' ebony stain, which is far cheaper than home-made or bought drawing ink.

Callipers, and How to Use Them

Unless measurements of a very accurate nature are required, the ordinary calliper is suitable if properly used. Both internal and external work can be measured in such an accurate manner that unless the work is required to be correct to, say, one-thousandth part of an inch, ordinary callipers are used. For the more accurate measurements, micrometers are employed, as fully explained later in these volumes.

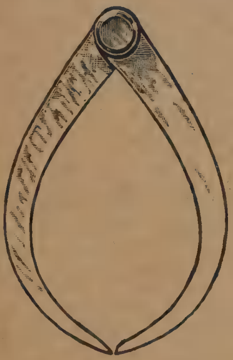


Fig. 1.—Ordinary Outside Calliper

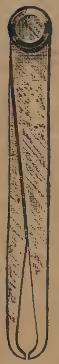


Fig. 2.—Ordinary Inside Calliper

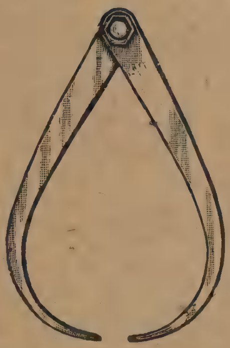


Fig. 3.—Firm-jointed Outside Calliper

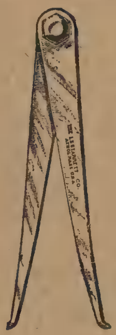


Fig. 4.—Firm-jointed Inside Calliper

Fig. 1 shows the ordinary outside calliper with riveted joint; and Fig. 2 an inside calliper of the same kind. This type of calliper is generally made by mechanics for their own use, but they are difficult to rivet up so that they can be opened and closed without any jumping.

A firm-jointed calliper is shown by Fig. 3, and a similar type, but for inside measurements, by Fig. 4. The joints of these callipers are held together by means of a small bolt, which is fitted with a hexagon head. The advantage of this type is that the nut may be tightened or slackened as desired, in order to make the callipers easy, or tight. Some special types of callipers are described later in this chapter.

Close Measurements with Callipers.—An experienced worker can measure, with callipers, to one-thousandth part of an inch, and to prove that this is so, a useful and interesting experiment can be made with a cigarette paper. This is generally one-thousandth of an inch thick (·001), and can often be used when work of a delicate nature or extreme accuracy is wanted. If a piece of perfectly cylindrical and smoothly finished iron or steel is obtained, it will be an easy matter to measure the cigarette paper, or in other words, to feel the difference that is caused by it being included in the measurement. This can be done as follows: Measure the bar very carefully with a pair of good smooth-pointed callipers, so that the points will only just touch the work. Then lay the cigarette paper on one side of the bar, place one calliper point on it, and then measure in the ordinary way. It is astonishing to feel the difference in the exertion that is required to make the callipers pass over the bar. Without the paper, the callipers pass over quite easily; but with the paper, the callipers are so to speak, pushed over.

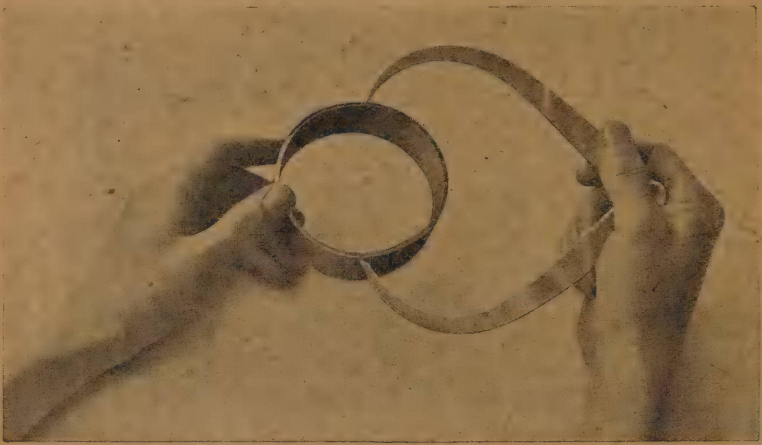


Fig. 5.—Using the Outside Callipers: the Callipers should be held more at right angles to the face of the work

Using Callipers.—In using a pair of callipers great care must be taken to hold them correctly. The points should be exactly opposite each other, and nicely rounded off with an oilstone in order that there are no sharp edges. The edges of the points should also be exactly parallel with each other, otherwise errors in measurement will take place, especially when they are being set to a dimension on a rule. Thus if the points are not exactly parallel with each other and the callipers are set to, say, 4 in. (using the widest end of the points), and work is turned to them, the result will be that the bar is under size. Now if the callipers are set to the nearest edges of the points the bar will be the correct size.

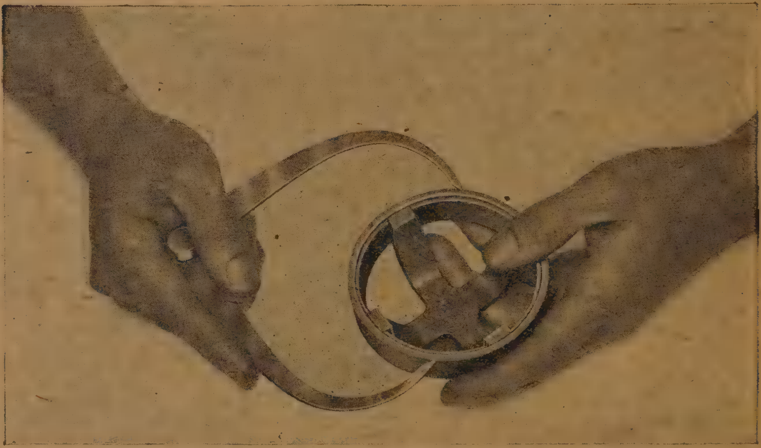


Fig. 6.—Inefficient Method of Holding Outside Callipers

In measuring external diameters, the callipers should be held with just sufficient force to prevent their falling, and it ought to be possible for them to fall over the work by their own weight. (For right and wrong ways, see Figs. 5 and 6.)

In measuring internal surfaces great care is necessary, more so even than for external surfaces. The points should be narrow and curved on the measuring surfaces. It should be possible to move the callipers sidewise to a very small degree in measuring holes. (For right and wrong ways, see Figs. 7 and 8.)

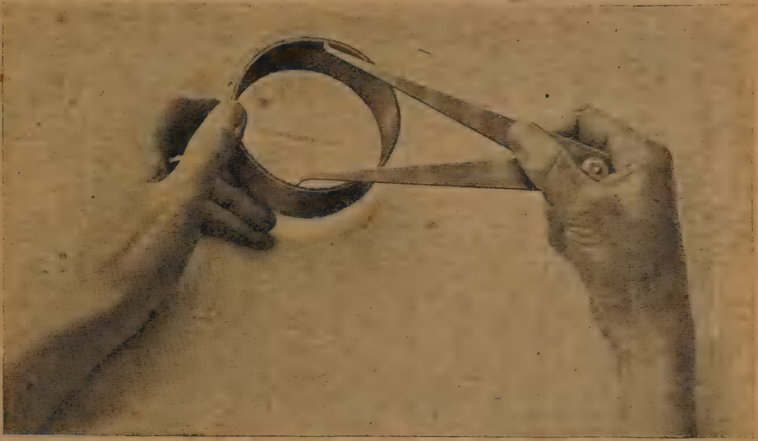


Fig. 7.—Using the Inside Callipers: the Callipers should be held more at right angles to the face of the work

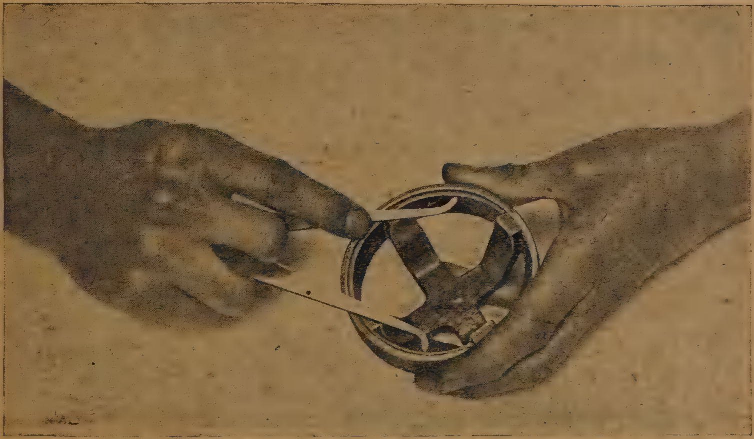


Fig. 8.—Inefficient Method of Holding Inside Callipers

Making a Pair of Callipers.—To make a pair of medium-size inside callipers, say about 6 in. long, it is necessary to obtain a piece of good smooth steel about 7 in. long, $\frac{7}{8}$ in. wide, and $\frac{3}{32}$ in. or so thick.

First scratch a line diagonally across the material, and carefully cut along this line with a sharp cold-chisel as shown in Fig. 9. Great care must be exercised in striking the chisel with the hammer when cutting near the end of the diagonal lines. If too much force is used the material will probably split and break through to the edge. The best plan is first to cut nearly through at the ends, and after that the cutting must be done very evenly all along the line.

If the chiselling has been done equally, the piece should come apart as in Fig. 10, which shows the rough broken edges. A $\frac{3}{16}$-in. hole, A (Fig. 11), should then be drilled in each piece, and it is desirable that the hole should be less in diameter than the rivet which is finally to be fitted. The two pieces can then be riveted together (see Fig. 12) side by side; that is, when the shape of one half coincides with the other. Then place the riveted piece in the vice and file up or grind on the outside edges. By being riveted together it is possible to finish the edges of both pieces alike, with a minimum expenditure of time and trouble.

After the edges have been smoothly filed up and polished, the ends or points, A (Fig. 13), should be heated to redness, and bent over as shown. The dotted lines indicate the position of the other leg when disconnected and turned over. Next file off the projecting portion and drill out, or knock out, the rivet.

Draw-filing and polishing the flat sides of the calliper legs is an easy operation,

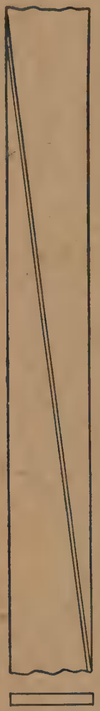


Fig. 9.—Steel Strip with Chisel Cut

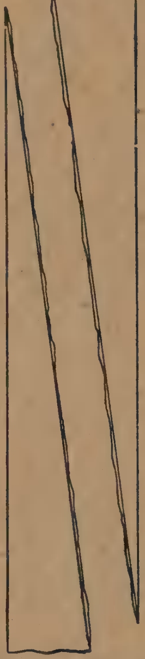


Fig. 10.—Steel Strip Broken Apart

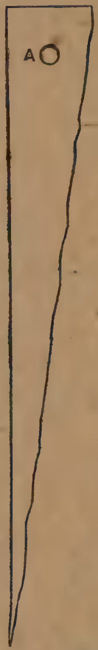


Fig. 11.—Calliper Leg Ready for Riveting

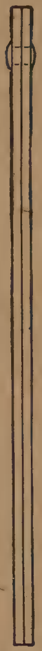


Fig. 12.—Calliper Legs Riveted Together

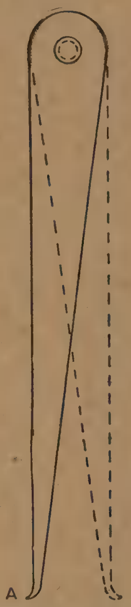


Fig. 13.—Calliper Legs Partly Finished

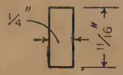
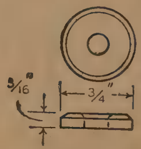
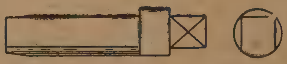


Fig. 19.—Rivet



Figs. 17 and 18.—Washer



Figs. 20 and 21.—Reamer

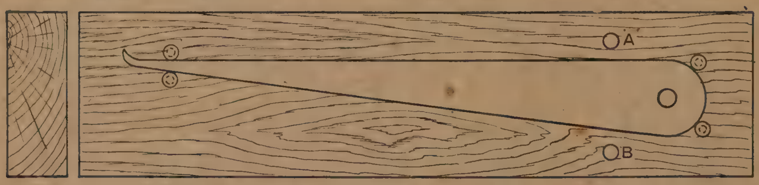
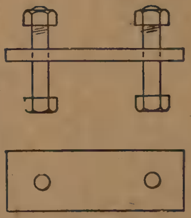


Fig. 14.—Calliper Leg in Position for Polishing



Figs. 15 and 16.—Clamp and Bolts

and to facilitate this a piece of wood about 7 in. long, 2 in. wide, and $\frac{3}{4}$ in. thick, should be fastened in the vice, and the calliper leg held from moving by driving six tacks or pegs in the wood, as shown in Fig. 14. Although this method allows of the polishing being done, it is recommended that two holes, A and B, should be drilled through the wood, and the calliper leg held down by means of the clamp and bolts (Figs. 15 and 16). If the latter method is adopted only part of the material can be draw-filed at a time. It will therefore require reversing from time to time and the draw-filed portion placed under the clamp. A very finely cut file should be used and should be drawn along the material in a succession of light to-and-fro rubs. If the steel is occasionally wetted, it will not be deeply scratched.

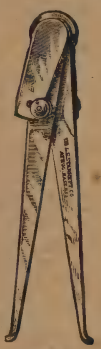


Fig. 22.—Inside Lock-joint Calliper

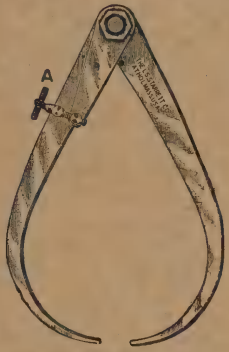


Fig. 23.—Adjusting Outside Calliper

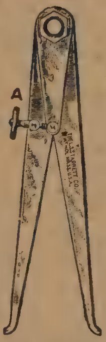


Fig. 24.—Adjusting Inside Calliper

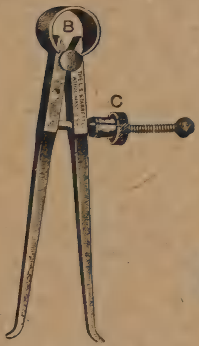


Fig. 25.—American Inside Calliper

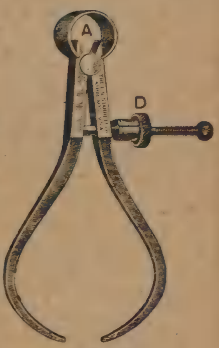


Fig. 26.—American Outside Calliper

After smooth-filing the legs they can be polished over with emery-cloth, tightly wrapped round a piece of hard wood about 12 in. long, $1\frac{1}{2}$ in. wide, and $\frac{1}{2}$ in. thick. The final polishing should be done with a piece of worn fine-grade emery-cloth well soaked with oil. If the polishing has been carefully done the material should present a good appearance. All corners should be kept square, as nothing looks worse than rounded or rubbed-off corners. The legs can now be greased over, and put aside until the washers and rivet are made.

The washers (Figs. 17 and 18), of which two are required, can be made from mild steel, but cast steel is much better. They should be turned with a very slight hollow on the under-side, or the part that rests on the calliper leg. The rivet (Fig. 19) should be made from hard steel. The writer prefers to use cast steel, but as great difficulty is experienced in riveting this, its use is not generally popular.

It is advisable to reamer out the holes in the callipers and in the washers before riveting up, and this should be done with all the parts in their correct position. This is necessary in order to obtain smooth movement when the parts are riveted together. If an ordinary reamer is not available, one can be made as shown by Figs. 20 and 21. It is made from a bar of round steel with three flats filed on and afterwards hardened. Some mechanics scrape up the surfaces of the calliper legs and the faces of the washers, and carefully fit them together, using red-lead to show the fit. This is a troublesome operation, but ensures a good job being made of the joint.

When riveting up, the rivet should fit the washers, and the calliper legs and the assembled parts should be held over an anvil. The rivet should project through the under-side washer and touch the anvil. The projecting rivet on the top side should then be gently struck round the edges with a round-ended hammer, until the counter-sink in the washer is filled up. The calliper should then be turned over and the process repeated on the other end of the rivet. When the callipers are tightened sufficiently the projecting portion of the rivet should be removed with a smooth file, finishing with fine emery-cloth. If the riveting has been carefully done it should not be possible to see the position of the rivet. The washers should be slightly smaller in diameter than the width of the calliper legs at the large end. This is necessary so that the parts can be filed to the shape of the washers after they are riveted together.

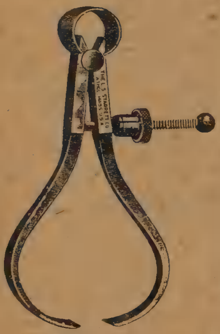


Fig. 27.—Screw-measuring Callipe-

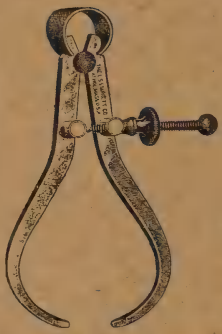


Fig. 28.—Screw-thread Calliper

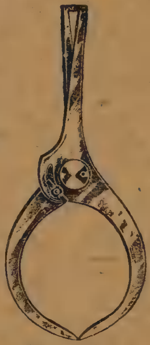


Fig. 29.—Double-ended Calliper

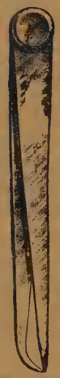


Fig. 30.—Hermaphrodite Calliper

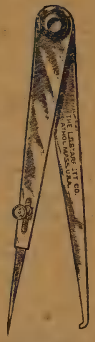


Fig. 31.—Adjustable-point Hermaphrodite

If the washers and rivet have been carefully made, and care has been exercised in the riveting, the washers will be exactly opposite each other, thus enabling a good finish to be made of the outside edges. A smooth file should be used for finishing, and it must be held at right angles to the washers, being used along, not across the material. After this draw-filing, oiled emery-cloth should be used.

The points should be hardened in the following manner before using: Heat the points to redness, quench for a moment in cold water, lay them on a piece of hot iron until a dark straw colour appears, and again cool in water.

The above instructions answer almost equally well for the making of outside callipers. The piece of steel from which the legs are cut is of the same thickness and general shape, except that a length of about 10 in. or so in the case of callipers to take 6 in. is advisable. Two triangular pieces are cut out as before, and the curved shape is obtained by bending the heated legs over the nose of an anvil, using as gauge or template a board on which the proper curve has been chalked. Riveting and finishing are exactly as already described in the case of the inside callipers.

Special Types of Callipers.—The lock-joint transfer calliper (Fig. 22) may be used inside chambered recesses, etc., it being possible to move one of the legs of the instrument and then bring it back to exactly its original position. This is done by loosening the nut that binds the one arm to the auxiliary leaf, and swinging in the arm (while the main joint is locked) in order to clear the obstruction. The arm or leg can then be brought back to the same place as before by means of a stop that is provided in the auxiliary arm.

When working to fine limits, the firm-jointed screw-adjusting callipers (Figs. 23 and 24) are desirable. These callipers can easily be adjusted by means of the screw, A, which is attached to the short auxiliary leg by means of a nut. This tool can be closed or opened to a size near the required dimension, and then adjusted by means of the thumbscrew. This type of calliper is really essential when delicate measurements are required.

The American inside and outside callipers (Figs. 25 and 26) are much used by mechanics on account of their being easily manipulated. These callipers are fitted with springs, A and B, the pressure from which constantly keeps them open and they are prevented from opening too far by the nuts C and D. These nuts are of special make and, as seen in the illustrations, are split. It is not necessary to turn the nut round in order to open the callipers, as by pressing on the milled head with a finger and thumb the two halves open at the end nearest the leg, and permit the nut to be moved instantaneously to an approximate position. The pressure from the circular springs, A and B, causes the nut to grip the thread tightly. A similar American calliper for measuring the outside diameter of screw threads is shown by Fig. 27, and a calliper for measuring at the bottom of thread by Fig. 28.

A special calliper for measuring either internal or external diameters is shown by Fig. 29. The advantage of its use is that the end that is not being used for measuring correctly registers the size of the article that is being callipered. Thus it is easily possible to measure inside recesses by means of this tool. Though this calliper is very useful for many purposes, it is not recommended for exact measurements, as sooner or later the measuring points are bound to wear, and it is impossible for both to wear alike.

The hermaphrodite (also called "odd legs," "jenny" and "moffs") calliper, shown by Fig. 30, is used for marking lines parallel with an edge, or for marking out the centre of a round or square bar. A better form is shown by Fig. 31, and this is provided with a hexagon nut at the joint, and with an adjustable scriber leg. The points wear with frequent use, and therefore require adjusting, which cannot be done with the calliper shown by Fig. 30.

There are other types of callipers, such as those used by boilermakers for measuring the thickness of plate some distance from the edge, and those used by smiths for measuring the diameter of red-hot iron bars, etc. The latter are fitted with a long handle, to protect the hand from the heat. These tools are not made as accurately as the callipers before described, as the dimensions are only intended to be approximate. It is evident that accurate measurements could not be obtained from red-hot material, owing to its expansion.

Fitting Wooden Bottoms to Metal Vessels

THE home mechanic may frequently find it handy to know that tin cans, zinc buckets, and oval-shaped zinc dishes or basins can be re-bottomed, when leaky, with wooden bottoms in the following manner: Pull out the old bottom with pincers, or in any other convenient way; cut a circular or oval piece of wood, as the case may be, ½ in. or ¾ in. thick, and, if for a bucket with tapering sides, large enough to drive in a tight fit. Taper the edges of the wood bottom to the same angle as the sides of the bucket. Do this carefully and truly circular. Then place inside the bucket, drive down to occupy the position of the old bottom seeing that it fits tight all round, and secure by driving in small flat-headed wire nails from the outside. Coat the under-side of the bottom with thick paint, and when the wood swells with being wet, a perfect water-tight bottom should be the result.

For a bucket with straight sides, cut the bottom as tight as can be got in and secure as before. Fit all from the inside and drive down, as this ensures a better fit. For large buckets, two pieces of board may be jointed together, giving the edges a coat of thick paint before joining. The heads of the nails may be dipped in white-lead before being driven in. Drive in the nails carefully so as not to miss the bottom.

Woodworking: Paring, Rebating and Chamfering

Paring Across the Grain. — After having done the sawing required for notchings, halving, etc., as explained in an earlier chapter, the waste wood is removed by paring. For small or superior work a good method of doing this is illustrated by Fig. 1, where the general position of the body during the operation is also shown. The work is held in the bench screw or secured to the top of the bench by means of a cramp or holdfast; and then, by holding the chisel horizontally with the right hand and controlling it with the left, thin shavings or parings should be taken off until the line is nearly reached. This is clearly indicated in Fig. 2, which shows the action of the chisel and also the method of removing the waste.

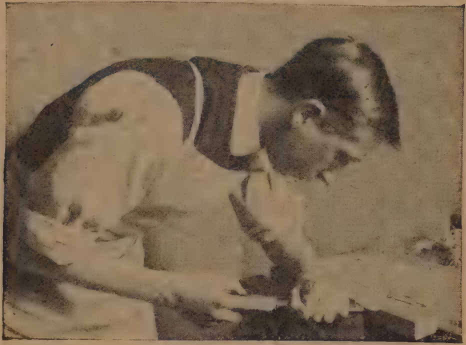


Fig. 1.—Paring Across the Grain

The paring is done from each side of the work, one half being removed from one side and then the work reversed and the other half cut away. If this procedure is followed, the liability of splitting a piece of the far edge of the notch will be obviated, whereas if the chisel is forced right through the waste a piece is frequently broken off, as shown at Fig. 3.

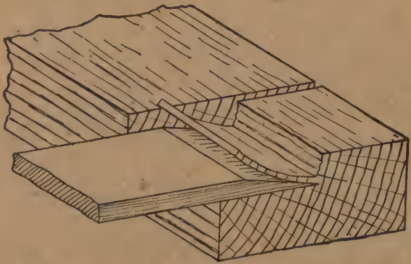


Fig. 2.—Action of Chisel when Paring Half-way Across Material

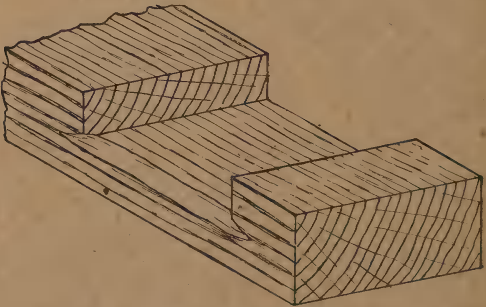


Fig. 3.—Effect of Paring from Only One Edge of Work

Another method of paring this kind of work is to hold the chisel so as to make the cuts slanting upwards as shown at Figs. 4 and 5, and then to pare down the high part in the middle until the desired flat surface is obtained. This is done by holding the chisel as in Fig. 6, the blade being held and guided by means of the thumb and first finger of the left hand, whilst with the right hand a sweeping motion from left to right is given, so that as far as possible the chisel shall not cut directly at right angles to the grain, but obliquely to it.

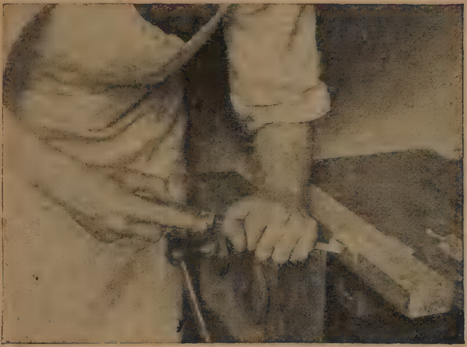


Fig. 4.—Alternative Method of Paring out Waste

Sometimes it happens that the saw kerf is not quite deep enough, and consequently after paring down exactly to the line, projecting chips or shavings will remain in the internal angles. These can be removed by holding the chisel with the flat side against the side of the cut, and, inclining the chisel forwards, drawing it backwards along the angle (see Fig. 7), so that the far corner of the chisel may cut the projecting chips and leave the internal angle clean.

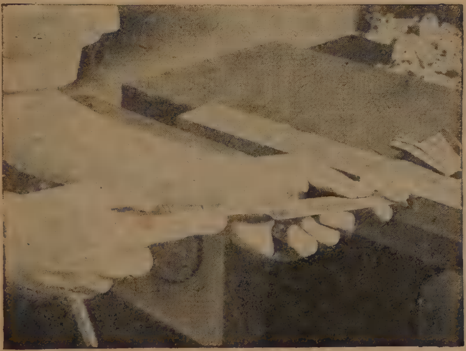


Fig. 6.—Smoothing Surface of Socket

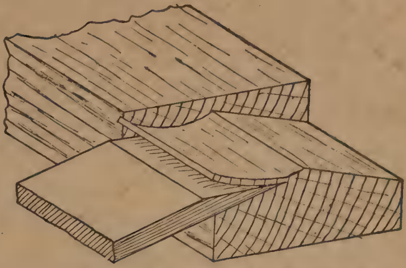


Fig. 5.—Action of Chisel used as in Fig 4.

Overhand or Shoulder Paring.—A more expeditious method of paring for a socket or housing is by means of overhand paring, shown by Fig. 8. The left hand and forearm rest on the work, and at the same time the former guides the chisel.

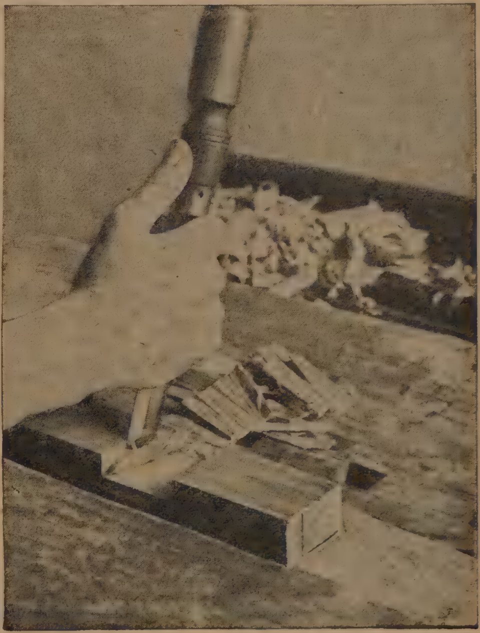
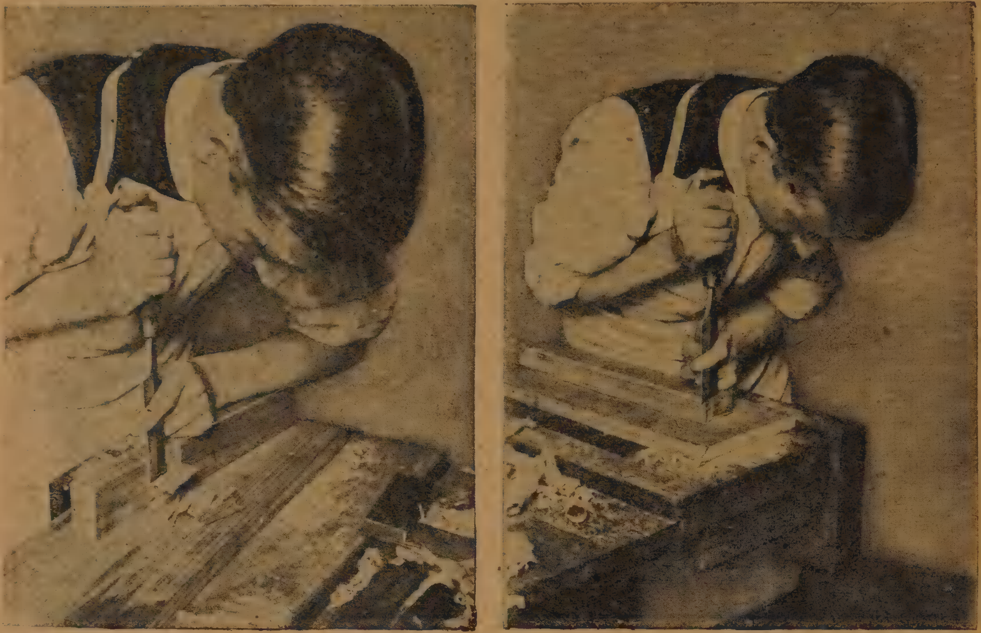


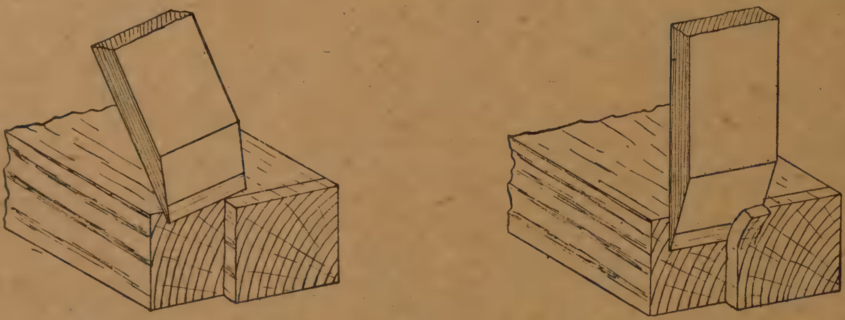
Fig. 7.—Clearing out an Angle

The right hand grasps the handle of the chisel, the thumb being placed on the top. The right shoulder is advanced so as to meet the hand and chisel handle, and is used to force the chisel downwards. The commonest fault with beginners using this method is that they do not keep the chisel upright, the principal cause being that they do not advance the right shoulder sufficiently. A slanting chisel either slips out or "digs in."



Figs. 8 and 9.—Overhand or Shoulder Paring Across Grain and of End Grain Respectively

Overhand Paring of End Grain.—Fig. 9 shows the general posture of the body when paring true and smooth the end of a piece of wood. As wood offers the greatest resistance to cutting across the grain, it follows that thinner and narrower shavings should be made at each stroke of the chisel than when cutting in other directions to the grain. Probably the best method is to start each downward stroke of the chisel by holding it in a



Figs. 10 and 11.—Different Stages in Overhand Paring of End Grain vertical plane, but inclining it a little to the right until it has entered the wood, as shown in Fig. 10. It should then be brought into a vertical position, as in Fig. 11. If this is carefully done, each cut will be in the same vertical plane as the preceding ones: that is, the end surface will be true. The exact size of the shaving depends, of course, upon the strength of the operator, the condition of the chisel edge, and the kind of wood being used; but the general fault with beginners is to try to take off shavings too wide and too thick.

Overhand Paring Obliquely with the Grain.—When doing paring of this description, always remember to start paring at the edge and keep working towards the end, as indicated by Fig. 12. If the chisel is operated from the edge of the work, the chisel will tend to follow the direction of the grain and result in the wood being split, as shown by Fig. 13.

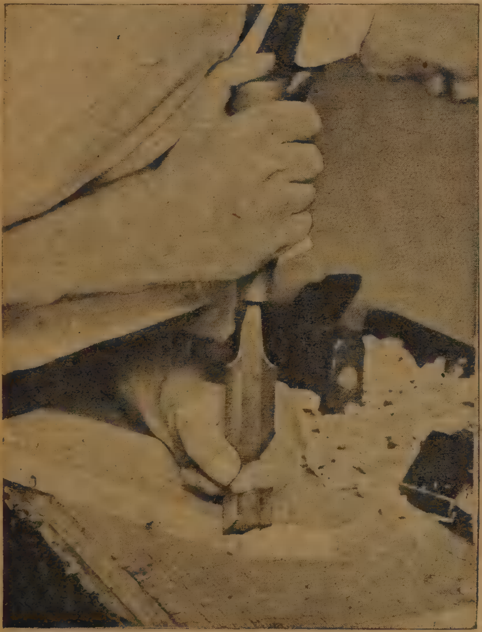


Fig. 12.—Overhand Paring Obliquely to Grain

Paring Obliquely to the Grain.—Whenever practicable, corners should be pared off by placing the work in the vice so that the chisel can be used in a nearly horizontal position, as shown in Fig. 14. If the corner to be removed is a large one, most of the superfluous wood should be sawn off and then carefully pared to the line. In using the chisel, simply thrusting forward should be avoided; but whilst moderately forcing the chisel forward with the right hand, the left should work the

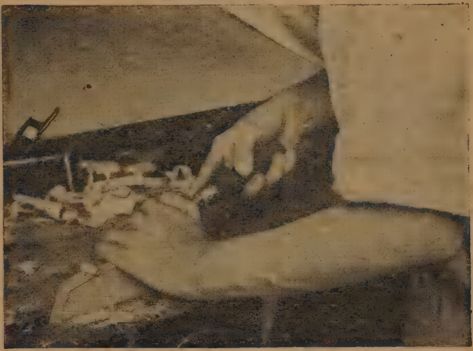


Fig. 14.—Paring off a Corner

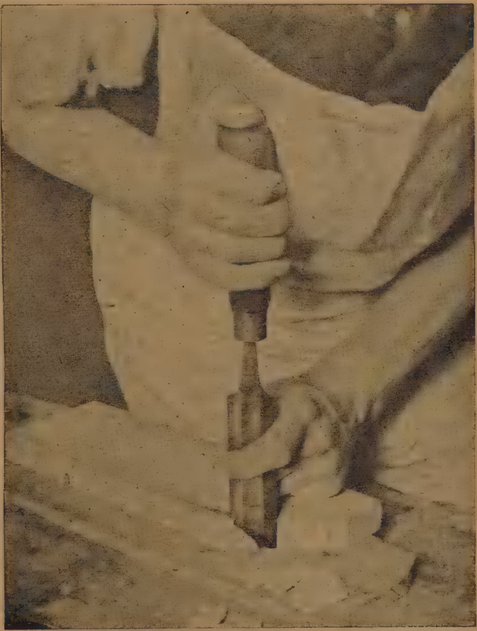
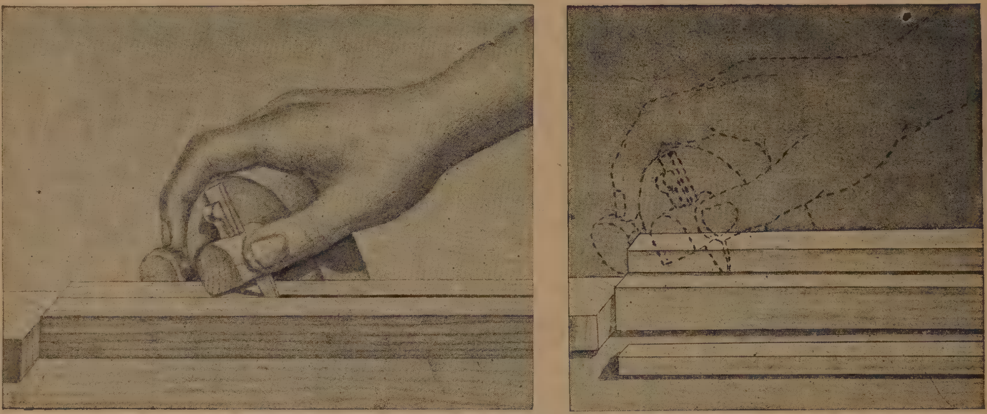


Fig. 13.—Wood Split by Incorrect Chiselling

chisel from left to right, so as to produce a cutting and not a shearing action.

REBATING

Small rebates can often be made by means of the cutting gauge. This tool and the method of using it are shown in Fig. 15. The stock of the gauge is set in the same way as that of the marking gauge, and the cutter or knife is held firmly in the shaft by means of a small metal wedge, by loosening which the cutter may be set so as to cut to any required depth. The rebate is worked by making a number of forward and backward strokes with the gauge, the cutting being done, of course, with the forward stroke. The cut having been made to the particular depth, the material is turned over, the gauge set to the other dimension of the rebate, and the previous operation repeated until the cutter reaches the level of the first gauge-cut. At this point the waste should fall out and a cleanly cut rebate remain, as shown at Fig. 16.



Figs. 15 and 16.—Rebating with the Cutting Gauge

Satisfactory rebating by this method depends chiefly upon two points: first, the straightness of the grain and the hardness of the wood to be rebated, and secondly, the strength of the operator's wrist. If the grain of the wood is not straight, the cut will not be very smoothly done, and the operator requires a strong wrist in order to keep the cutter from following the grain, and sometimes pushing the stock of the gauge away from the face of the wood.

Fig. 17 shows the usual way of rebating—that is, by means of a rebate plane. Here it will be seen that a strip of wood is fixed to the work by a couple of sprigs so that the inner edge coincides with the gauge line. The rebate is made by working the plane against this strip of wood, which serves as a fence, until the required depth is reached. This method, however, is often objectionable because of the damage to the work caused by the nails. To avoid this a simple contrivance may be arranged as illustrated by Fig. 18. It consists of a piece of board, housed on the under-side a short distance from the end to receive the bottoms of G cramps. This is screwed down to the bench as indicated, the work laid upon it, and then a piece of wood adjusted to the gauge line and the cramps screwed up to hold the different pieces in position. A couple of cramps for this purpose may be purchased, the common kind for twopence or threepence. The rebate is then made by working the plane against the topmost piece, as previously described.

Those who do not possess a rebate plane can easily improvise one, as shown in Fig. 19. A piece of wood about 7 in. long, $3\frac{1}{2}$ in. wide, and $1\frac{1}{4}$ in. thick, has a wedge-shaped housing made in it about

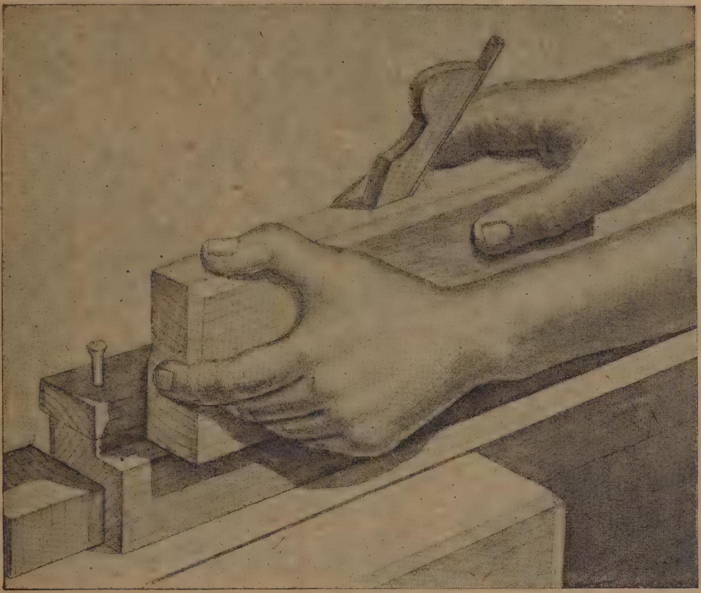


Fig. 17

$\frac{3}{4}$ in. deep, so as to take a $\frac{3}{4}$-in. chisel. A curved piece is then removed from the upper side of the housing to form a mouth, and a wedge made and fitted as shown. A piece of wood is then screwed on the under-side to form a fence, as represented in the figure. This fence can, of course, be screwed on at any distance from the face of the plane (less than $\frac{3}{4}$ in.), to suit any particular rebate it is required to make.

A useful example, affording good practice in rebating, is shown by Fig. 20, which represents a rebated frame. A frame such as this would do for a variety of purposes, such as a picture frame or small door, if fitted with a wood, glass, or wire panel. Fig. 21 shows one stile and one rail in three stages of construction. First, set out and sawing with the grain done in the waste; secondly, rebated; third, the shoulders cut and the joints ready for putting together. If the frame is small, the rebating can be done with a cutting gauge; if large, with a rebate plane, as the gauge leaves a rough finish.

Cross Lap Joint.—Fig. 22 is a general view of an ordinary cross lap joint completed. The material for this joint is shown planed up and set out, also sawn and pared, ready for fitting together at Fig. 23.

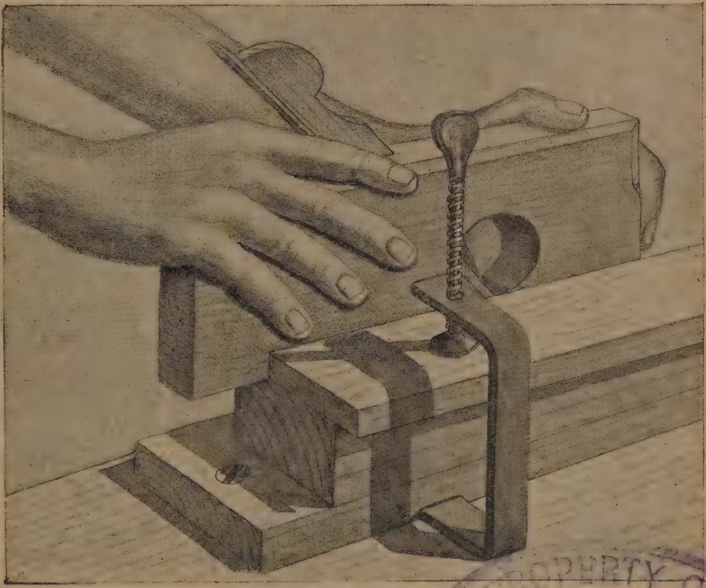


Fig. 18

Figs. 17 and 18.—Rebating with a Rebating Plane

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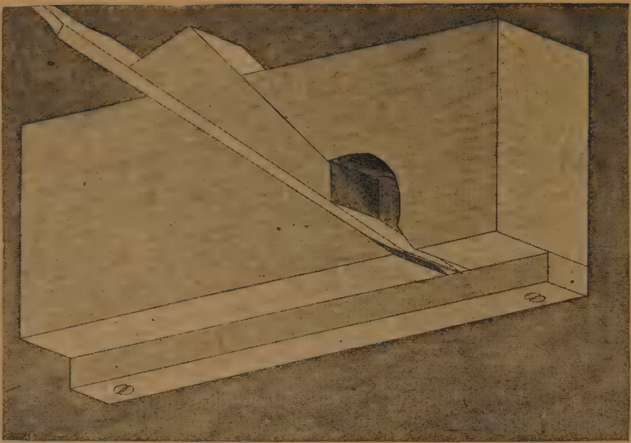


Fig. 19.—Improvised Rebate Plane

Stopped Rebating.—It is often desirable to make rebates which do not continue to either one or both ends of the work. In this case, before the rebating can be done with a cutting gauge or rebate plane, it is necessary to make a portion of the rebate near the stopped end by means of a chisel and saw. A saw cut should first be made at each end of what is to be the portion of rebate. This is done by holding the saw in a slanting position so as to make a saw kerf which terminates at each of the gauge lines. Then, with a chisel and a mallet, a number of cuts should be made as shown in the upper diagram of Fig. 24. The lower diagram shows the appearance of the work after the portion of the waste has been removed. The portion of rebate is then finished by vertical and horizontal paring, as illustrated at Fig. 25. If the rebate is small and the material suitable, the rebating can be completed with the cutting gauge, if not, it can be done with a rebate plane, but usually the ordinary rebate plane requires a large portion of the rebate to be made with a chisel first. This can be largely obviated

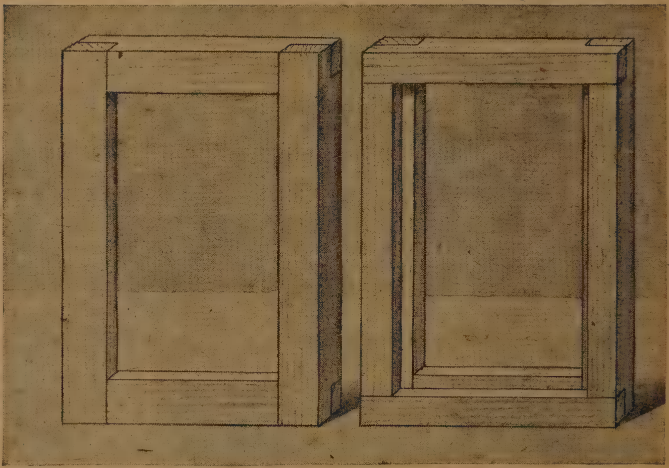


Fig. 20.—Front and Back Views of Rebated Frame

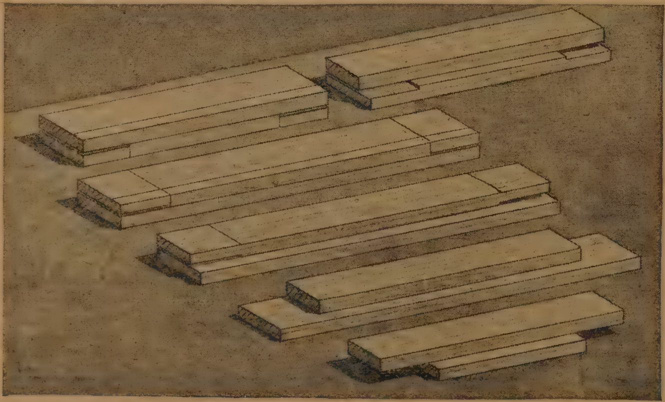


Fig. 21.—Three Stages in Making Rebated Frame

by using a bull-nose plane, as shown at Fig. 26. It will be seen that the iron is very near the front end, and thus very little of the rebate has to be made with a chisel. At the other end of the work, in order to avoid chiselling the rebate for a distance equal to at least that between the cutting iron and the back of the plane, the latter is reversed and the rebate worked down as required.

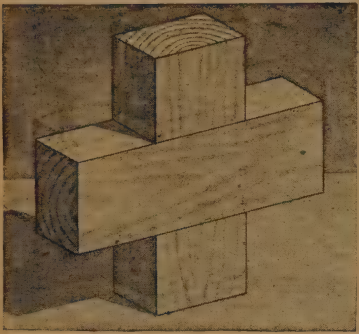


Fig. 22.—Cross Lap Joint

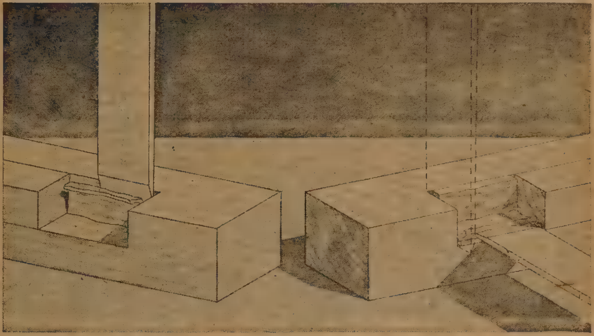


Fig. 25.—Paring in Making a Stopped Rebate

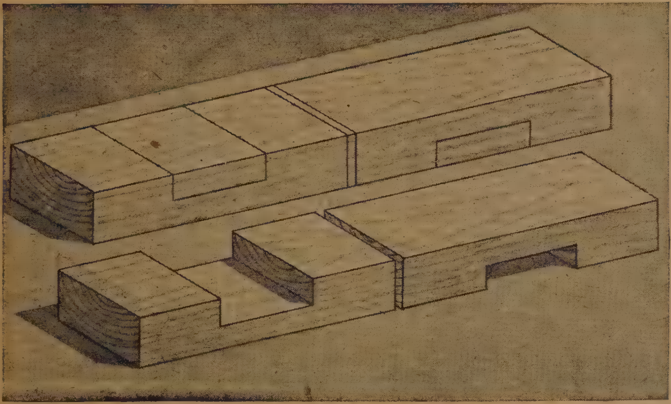


Fig. 23.—Two Stages in Making Cross Lap Joint

Rebated Oxford Frame.—A suggestive and useful article to make, and one that introduces stopped rebating, is an Oxford frame, front and back views of which are shown by Fig. 27. In the upper diagram of Fig. 28 is shown the setting of the halving for one corner of the frame; below it, the halvings made, and the gauging for the rebate done. In the lower diagram the joint is represented fitted together. It will be seen that this frame is stopped rebated. Therefore, when the four joints of the frame have been put together the pieces should be separated, and at least two of the pieces will require a portion of the

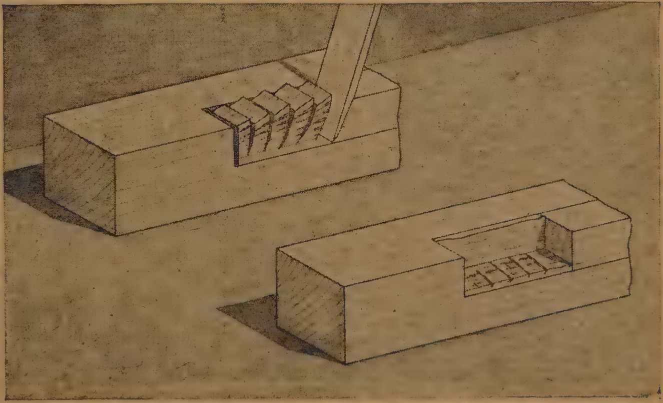


Fig. 24.—Making a Stopped Rebate

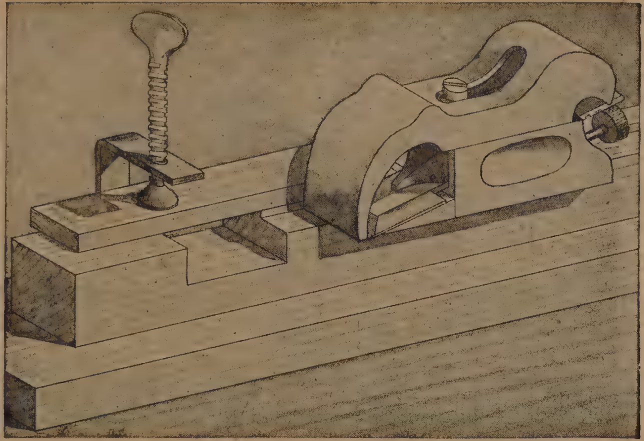


Fig. 26.—Using Bull-nose Plane

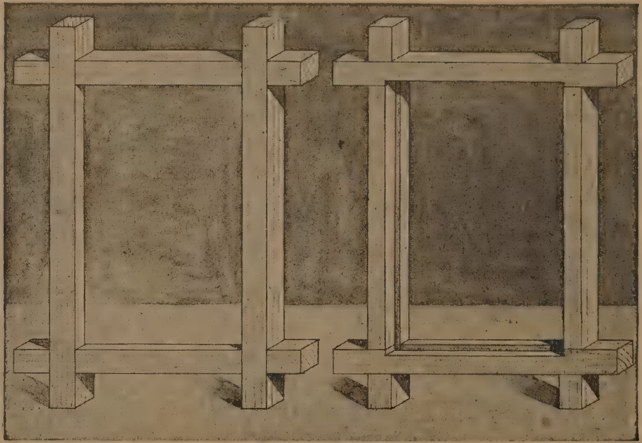
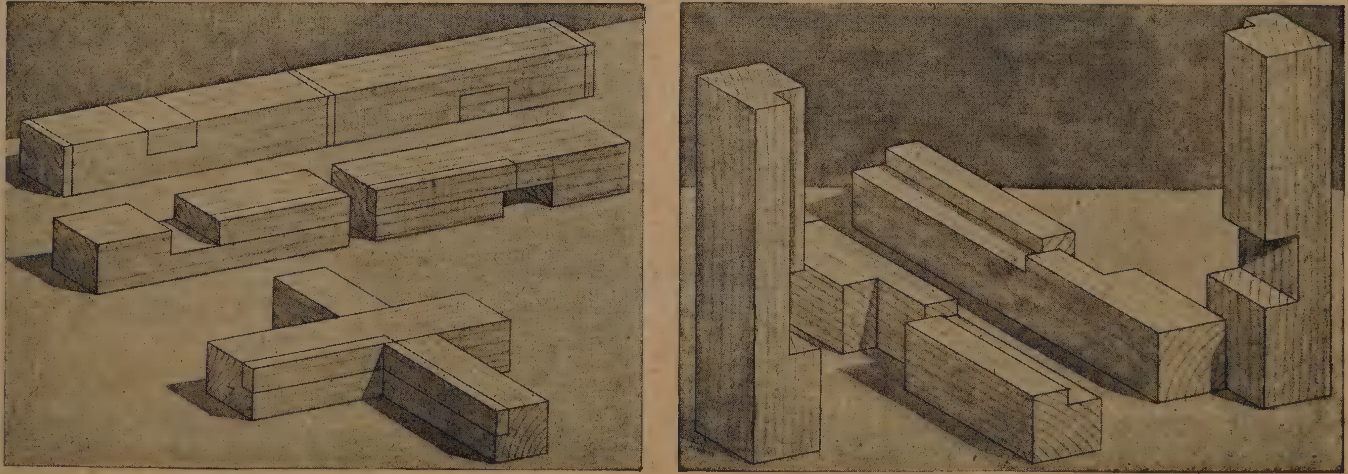


Fig. 27.—Front and Back Views of Oxford Frame



Figs. 28 and 29.—Stages in Making an Oxford Rebated Frame

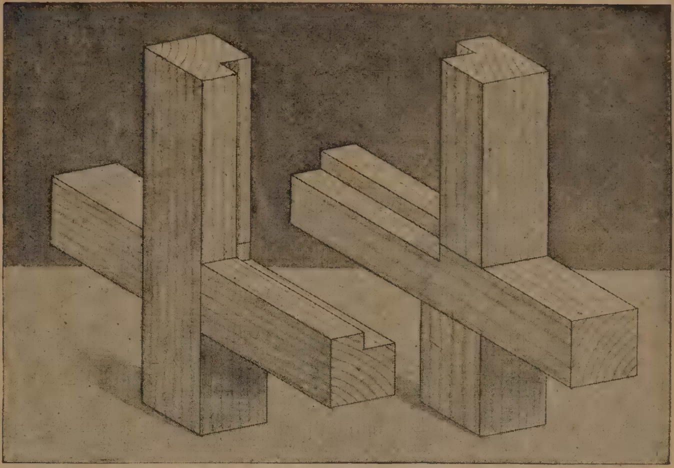


Fig. 30.—Corner of Oxford Rebated Frame

rebate to be made with a chisel and the remainder completed either with the cutting gauge or with the rebate plane, as already described. At Fig. 29 two views are given of one corner of the frame, separated, and at Fig. 30 two views of the same corner put together.

CHAMFERING

The appearance of many articles can be much improved by various forms of chamfering; the methods of doing such work will therefore be described in detail. A good object to start with is a model octagonal prism, which can be converted afterwards, if desired, into cylindrical form and be used as a blind roller, round ruler, or even a rolling pin.

Should it be desired to make an octagonal prism from a piece of square wood, the first stage will be to plane up the stuff quite square in section. Then on one end of the piece draw the diagonals of the square and set the marking gauge to a distance equal to half of a diagonal, as illustrated in Figs. 31 and 32. Then, with the gauge set to this distance, mark the eight gauge lines (see Fig. 33). Of course, the stock of the gauge will rub against each face of the work twice in order to gauge these eight lines. The extremities of these lines should then be joined as shown (Figs. 32 and 33 make clear the geometrical principle involved in this method). The work should then be placed with one of the diagonals vertical, and the chamfer made by planing down to the gauge lines, this process being repeated, of course, three times. In order to do this kind of work with facility, a cradle of some kind is required

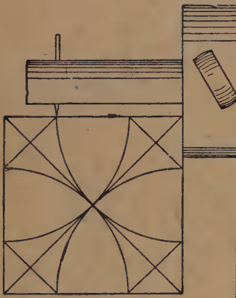


Fig. 31.—Setting Out Octagon, and Setting the Gauge Before Chamfering

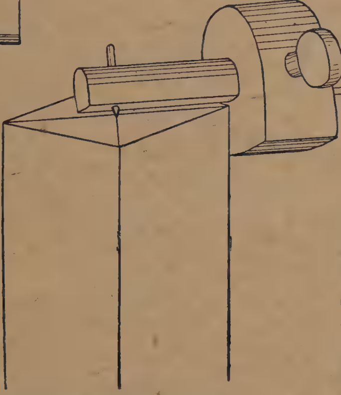


Fig. 32.—Setting Gauge to Half Diagonal

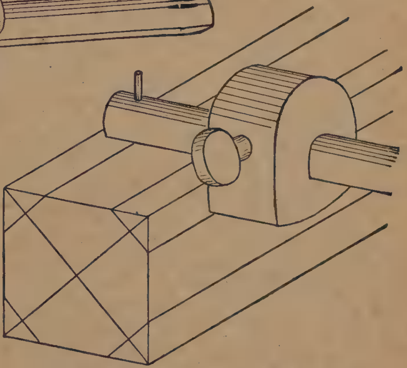


Fig. 33.—Gauging for Chamfering

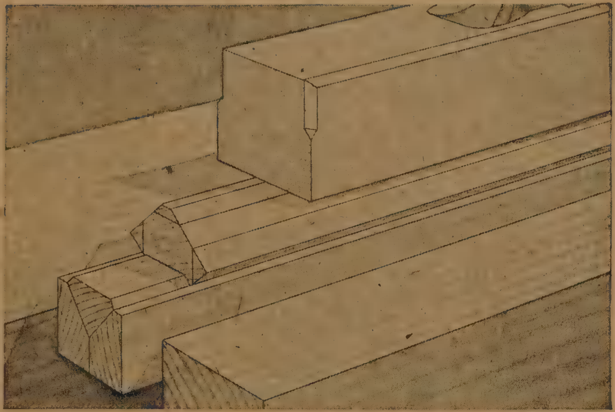


Fig. 34.—Chamfering with Jack Plane

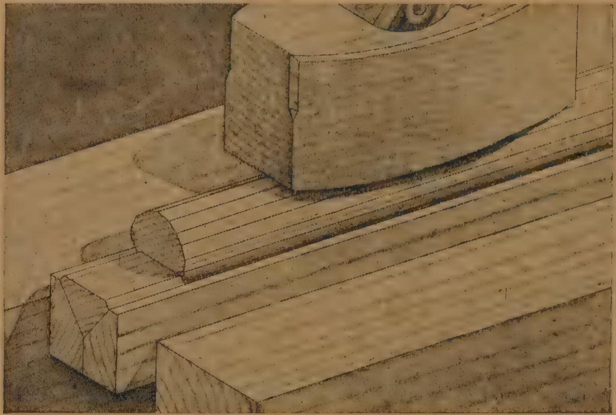


Fig. 35.—Chamfering with Smoothing Plane

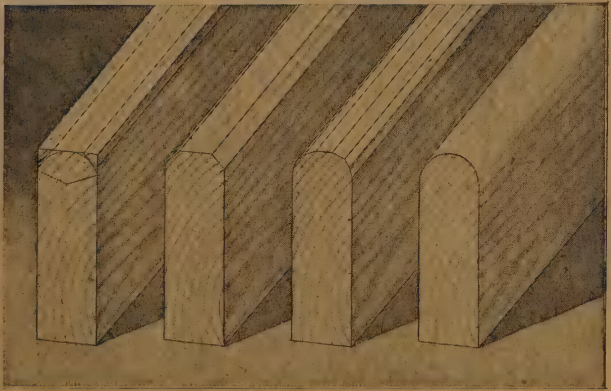


Fig. 36.—The Four Stages of Rounding an Edge

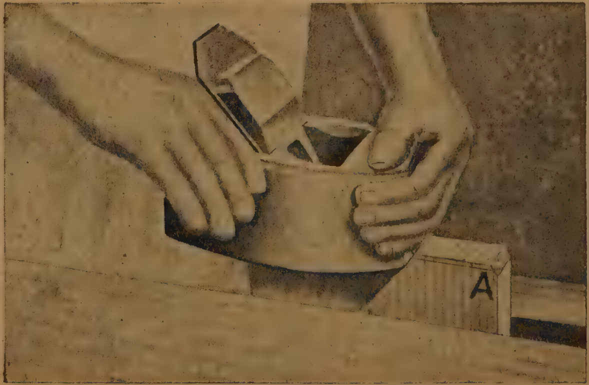


Fig. 37.—Planing End Grain

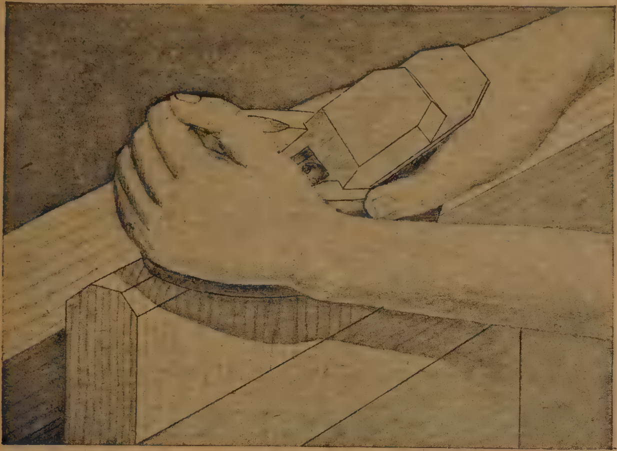


Fig. 38.—Chamfering End Grain with Smoothing Plane

to hold the piece firmly, while the planing is done, and a simple form is shown at Fig. 34. It is made by chamfering two strips of wood along one edge and nailing them together so that they form a **V**-groove. A piece of wood about 2 in. long is then fitted into the groove and fixed by nails or screws at one end of the cradle as shown, so as to form a stop against which the work may be placed.

If it is desired to turn the preceding octagonal prism into cylindrical form, each of the eight arrises should be planed off so as to form a prism with sixteen sides. This may be done with either the jack plane or smoothing plane. Next, each of the sixteen sides should be removed by means of a smoothing plane (see Fig. 35) which has been set very finely so as to form a prism having thirty-two sides. If this is carefully done there should be little difficulty in taking off the thirty-two arrises so as to bring the prism to an approximately cylindrical form. It should then be finished with fine No. 2 or No. 1 glasspaper.

Rounding an Edge.—It is frequently desired to round off the edges of some articles as a decorative feature. Although the method of doing this is much the same as that adopted in the preceding example, there is a slight difference between them which is useful to mention. The rounded edge is seldom semicircular in section, being usually not more than a sector of a circle containing an angle of about 150°, as shown in the first diagram of Fig. 36, where the rounding off of an edge is shown in four stages of formation.

Planing End Grain.—Having described the procedure to be followed when chamfering and rounding with the grain, it now remains to describe how this may be done across the grain ; but before this kind of chamfering and rounding can be done it is necessary to plane the ends of the work true and square with one face and edge. At Fig. 37 is shown the method of holding the plane when removing the waste. As, of course, the extreme part of the work, shown at A, is liable to split off, it is a good plan to pare off with a chisel the corner on the splay so that the lower edge is on a level with the gauge line as

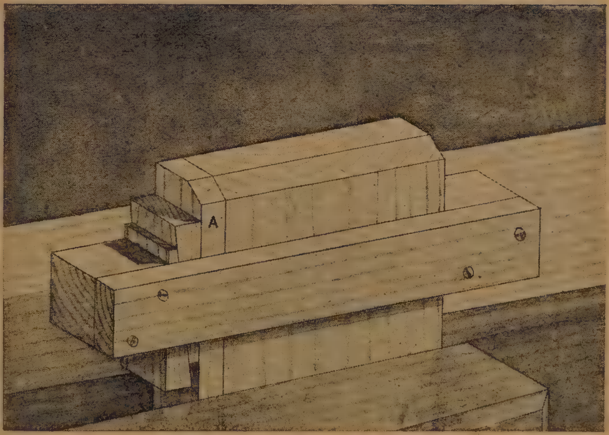


Fig. 39.—Piece of Waste Clamped to Work to Obviate Splitting

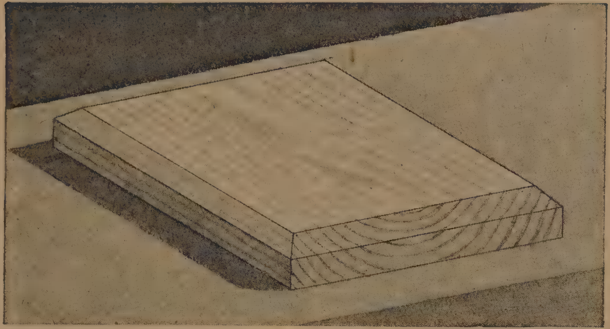


Fig. 40.—Chamfered Square Mat

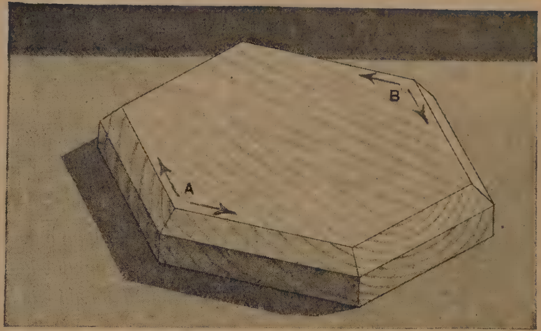


Fig. 43.—Hexagonal Mat

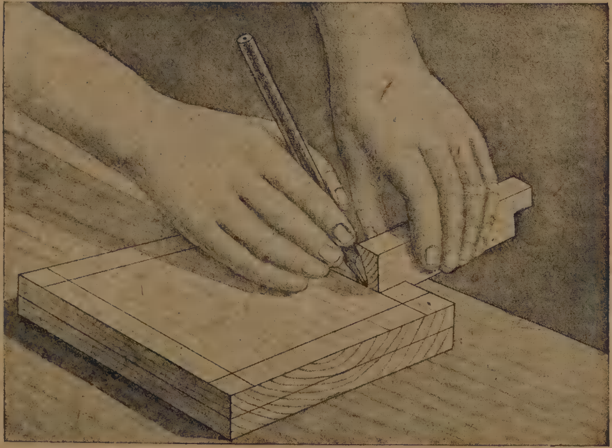


Fig. 41.—Gauging for Chamfering the Mat

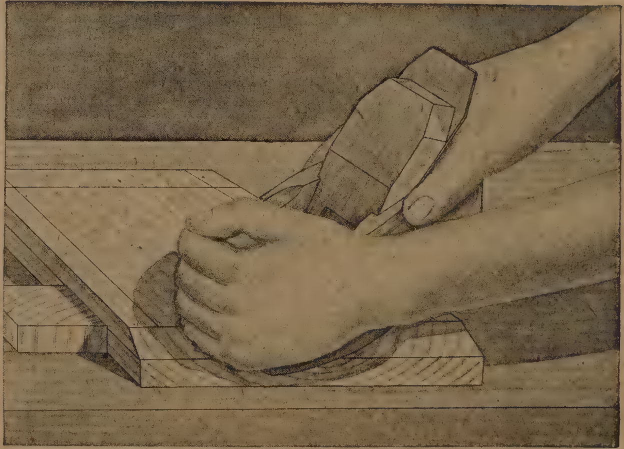


Fig. 42.—Chamfering End Grain of Mat

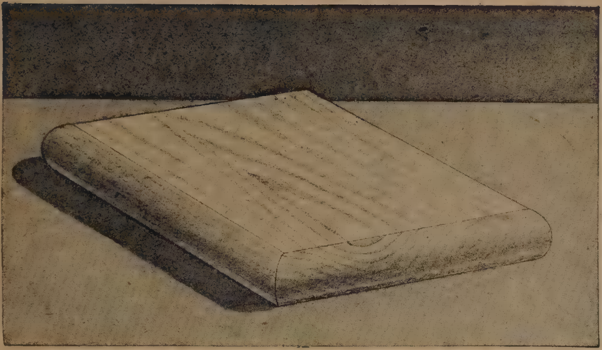


Fig. 44.—Square Mat with Rounded Edges

shown. If, however, the end has merely to be cleaned or smoothed off, and as little as possible is to be removed, then it is incumbent that the planing should be done from each end. Or, an excellent way is to clamp an odd strip of wood against the edge towards which the cutting is done so as to prevent the edge splitting. This is shown at Fig. 39.

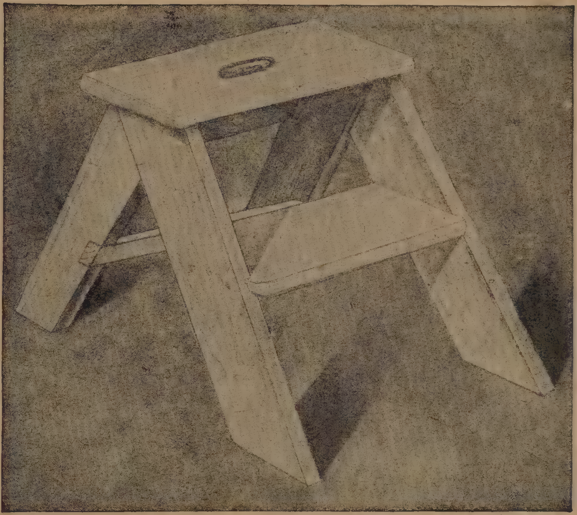
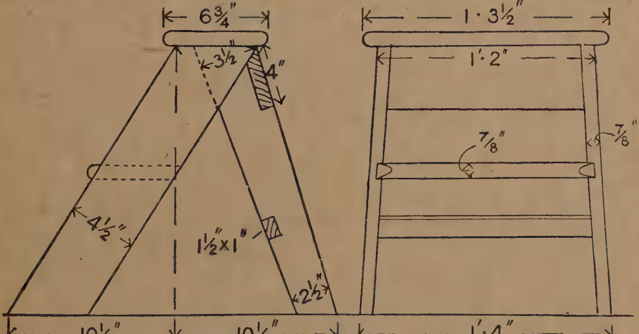


Fig. 45.—Dwarf Steps

Chamfering End Grain with Smoothing Plane.—When chamfering or rounding off end grain, in order to prevent splitting at the edges, and also in order to secure a smooth surface, the plane should be held in the manner indicated at Fig. 38, from which it will be seen that the cutting is done obliquely to the grain. When working on end grain and making chamfers or rounds upon it, all chances of splitting are obviated if a piece of waste A (Fig. 39) is cramped to the edge towards which the planing is being done, by means of an iron or wooden cramp, or an improvised cramp, which is also shown in the illustration.



Figs. 46 and 47.—Two Elevations of Dwarf Steps

Chamfered Square Mat.—Very good practice in chamfering can be secured by making a square mat chamfered along each edge. The finished model is shown by Fig. 40. Having planed up the piece of wood to the sizes previously decided upon, the setting out for the chamfering can be proceeded with. A marking gauge may be used in doing this, but as the gauge lines, unless they are very lightly impressed, are liable to produce blunt arrises in the hands of a beginner, many prefer to use a gauge for the purpose (see Fig. 41). This is simply a piece of wood having a notch at one or both ends. If the breadth of the chamfer it is required to make is the same as its depth, then only one notch is required; but if, on the other hand, the breadth and depth of the chamfer are unequal, then one notch equal to the breadth, and one equal to the depth must be made. In this case the breadth and the depth are unequal, hence the presence of two notches.

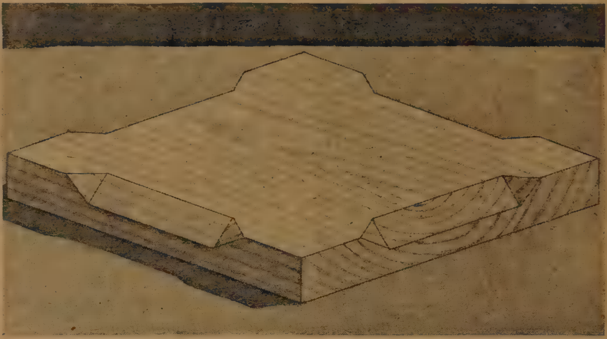


Fig. 49.—Square Base Stop-chamfered

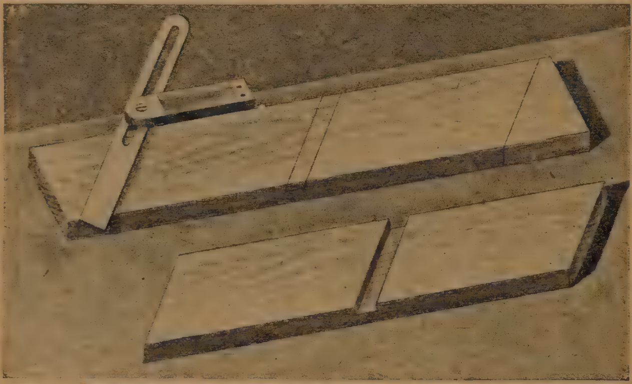


Fig. 48.—Working the Side of Dwarf Steps

In chamfering an article of this description, the work should be firmly fixed to the bench by a holdfast, or any other available and suitable means, and the chamfering started on the end grain. The plane should be held in an oblique position so that the cutting edge is able to cut and not shear the grain. This will be clear after referring to Fig. 42. Having chamfered one end the other edges should be chamfered in rotation.

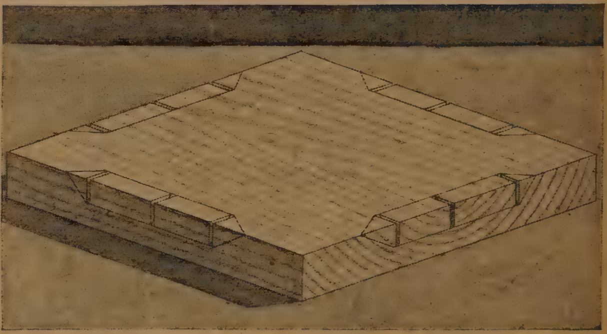


Fig. 50.—Base Set Out and Saw Kerfs Cut

Hexagonal Chamfered Stand or Mat.—An excellent example illustrative of the way in which splitting can be avoided when dealing with end grain is afforded by the making of an hexagonal mat, such as is illustrated in Fig. 43. If the surface planing were to be done from A to B the corners might be broken off; but by proceeding in the directions indicated by the arrows, they are retained and the surface made smooth.

Square Base with Rounded Edges.—In order to gain a little practice in rounding off end grain it would be well to make the square base represented by Fig. 44, where it will be seen that the model has

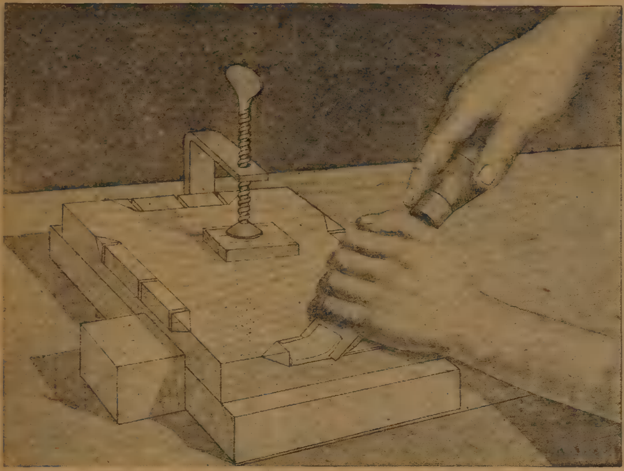


Fig. 52.—Holding Chisel when Removing Waste

all its four edges rounded off. In doing this it will be found best to round off the end grain first and then to chamfer the sides.

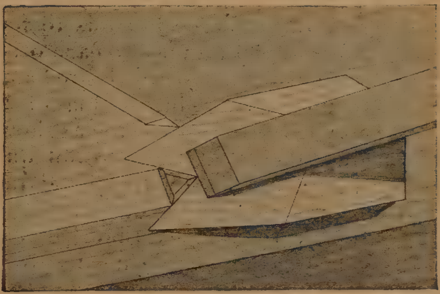


Fig. 51.—Using Template in Finishing Stop

Dwarf Steps.—Fig. 45 is a perspective view of dwarf steps which provide an excellent application of the various toolwork operations already described. Suggestive dimensions are given in Figs. 46 and 47; while Fig. 48 shows the setting out of one side, for which work a bevel will be found very useful. The finished side is also shown, housed and cut off to length ready for fitting together. The legs and sides are halved together at the top as indicated by the dotted lines in the side elevation (Fig. 46). The upper back rail is let into, to the half or the whole of its thickness, the back of the legs, and the legs are notched to receive the lower back rail. The top is housed to receive the upper ends of the sides, and its edges are rounded off. The top should be bored and the waste pared out so as to form a hole in which to place the hand when lifting the steps. The front edge of the step is rounded off, and the back edge is splayed at the same angle as the inclination of the sides. The whole can be fixed with glue and nails.

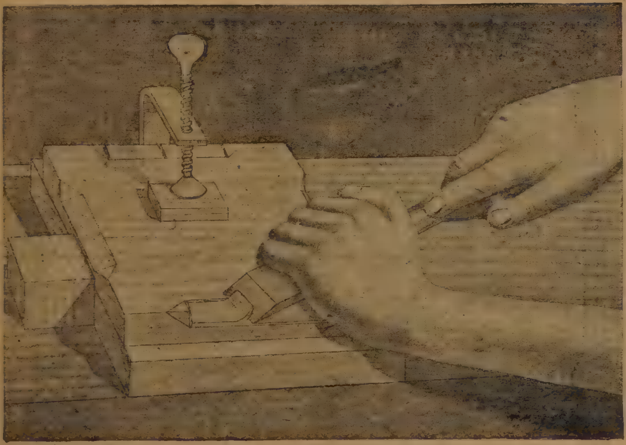


Fig. 53.—Alternative Method of Holding Chisel

Stop Chamfering with Chisel.—As a first example in stop chamfering the article shown at Fig. 49 may be made; it will be found to give good practice in this form of ornamentation. Fig. 50 shows the material trued up to size and set out for chamfering. The splays for the stops may be marked out by means of a bevel or with a template (Fig. 51) con-

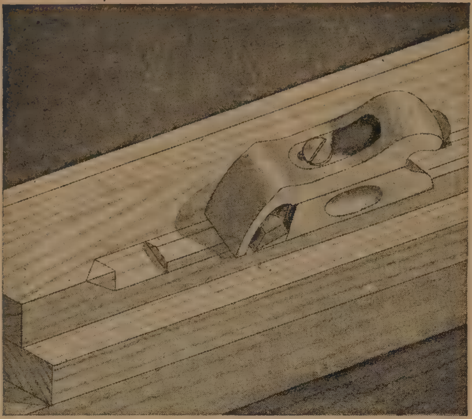


Fig. 54.—Using Bull-nose Plane for Long Chamfer

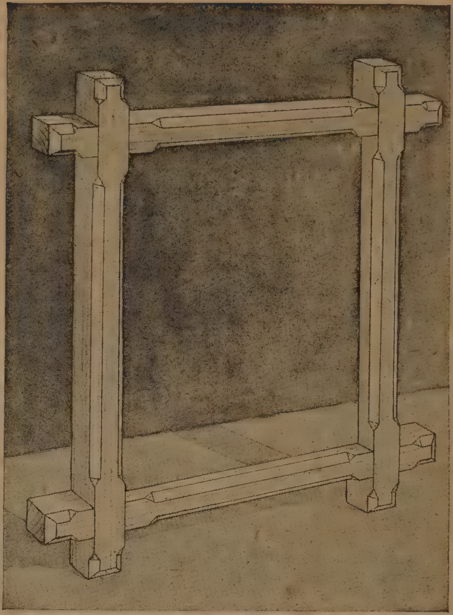


Fig. 55.—Oxford Frame Stop-chamfered

sisting of a piece of wood which has been rebated on the under side so as to form two surfaces at right angles to each other, one end being splayed at the desired angle corresponding to the inclination of the stop. Saw kerfs are next made as shown, care being taken that they do not quite touch the lines. The work should next be firmly cramped either directly to the bench top or to a block that has been securely fastened by some means to the bench. Then, with a freshly ground and sharpened chisel held as in Fig. 52, most of the superfluous wood can be removed. Observe that the bevel of the chisel rests upon the work. When using hardwood and working end grain, it may sometimes be necessary to use a mallet to remove the greater part of the waste, but, of course, a little must be left so that the chamfer can be finished by careful paring to the lines. Generally, the chiselling can be done best by using the chisel so that its flat face is held firmly against the surface which is being pared, as in Fig. 53. At the same time the cutting edge should be slid up and down as well as pushed forward. By following out this procedure more satisfactory results will be obtained than if the chisel is simply pushed forward, especially when paring end grain. When a number of similar stops has to be made it saves time and makes for greater accuracy if a template is made. This is held to the work and the back of

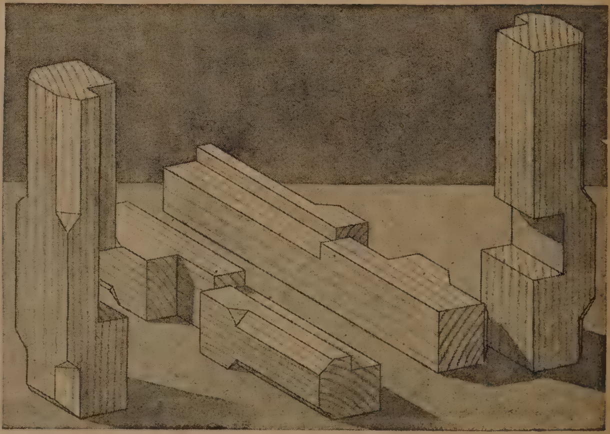


Fig. 56.—Oxford Frame: The Joint Apart

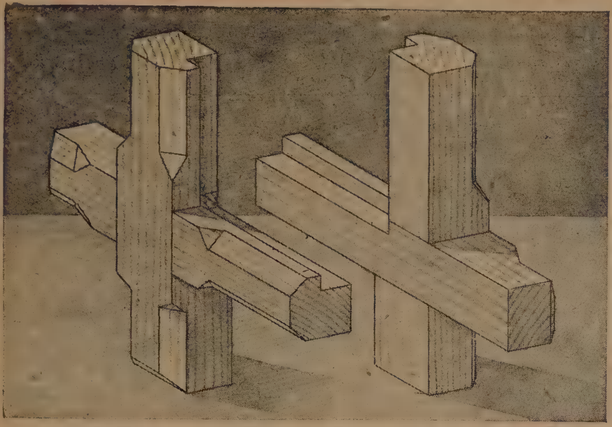


Fig. 57.—Oxford Frame: The Joint Assembled

the chisel simultaneously kept in close contact with the splayed end of the template and pushed forward as illustrated at Fig. 51. When making stop chamfers 6 in. or more in length, a short portion should be made at each end by paring with the chisel, and the remainder removed by planing. A very useful plane for this purpose is the bull nose, one form of which is shown in use in Fig. 54. There is a large variety of iron bull-nose planes now available. A particularly useful tool is a combined rebating and right and left fillister plane.

Oxford Frame.—Another article that gives good practice in stop chamfering is an Oxford frame, a perspective view of which is given by Fig. 55. The views of one joint of the frame are fully shown by Figs. 56 and 57, which will convey a clear idea of the construction.

Making a Cartesian Diver or Bottle Imp

The cartesian diver or bottle imp is more than a toy—it is an appliance demonstrating a number of scientific truths. A tightly covered bottle contains a small figure immersed in water, and at the command of the performer the figure is seen to sink and rise in the bottle.

The instrument depends for its working on the principle that when a body is in a liquid it will float if it be lighter than an equal volume of the liquid; but if heavier, it will sink. Thus, if the weight of a body can be varied relative to the supporting liquid, it may be caused to float or sink at pleasure; or, by careful working, it may be caused to remain at any desired depth in the fluid.

Get a tall glass jar, fill about seven-eighths with water, and insert the cartesian figure—a hollow glass figure having a tail in which is a hole. By alternately dipping it in hot and cold water, so adjust the quantity of water in the hollow body (the water enters at the end of the tail) that it will float with the top of the figure exactly at the surface of the liquid. This will take some little time; but on the careful adjustment of the weight of the figure the whole success of the experiment depends. Now take hold of the figure by the feet, and turn it head downwards in the water. It will try to float out; but stretch a sheet of indiarubber tightly over the jar, and tie it securely, making sure that it is both air-tight and water-tight. Then turn the jar upside down, when the figure will be the right side up, and will float to the top of the jar. It will now be found that if the slightest pressure be exerted on the indiarubber covering of the end, the diver will sink. This is caused by the air pressure being transmitted to the end of the tail of the diver, hence a little water will enter. And as the diver is exactly balanced, this little additional water makes the diver heavier than an equal volume of water, and it very slowly sinks. When the pressure is released, the expansion of the air in the diver forces out the water, and it rises to the top.

Re-taping and Re-painting Venetian Blinds

Once a year venetian blinds need to be well cleaned, and every few years they require new tapes and cords and to be re-painted. Housekeepers generally send for a local cabinet-maker or upholsterer to do the work, but any average handy-man should be able to manage it quite as well. Whether it is a matter of cleaning only or of new tapes, the process of fitting up is the same.

It is waste of time to sew broken tapes, the first break being a sure sign that it is time to renew. When new tapes and cords only are required, the workman measures the size of the ladder tape between the lath supports, or, better still, he takes a cutting of the old tapes and is particular to get exactly the same size, because should he get the wrong size tape the blind will be too long or too short. The re-taping and cording are done in place on the window.

Removing Venetian Blinds.—The blinds are sometimes fixed with two screws through the top lath into the window framing, and sometimes on two small iron angle-brackets. The second method is the better, and in workshop practice the two brackets are fixed on a board for hanging the blinds. Fig. 1 shows a blind of which the laths and tapes need to be cleaned and the cords renewed. It is desirable, also, to fit a check movement, which is a great improvement on winding the pull cords on hooks attached to the window casing.

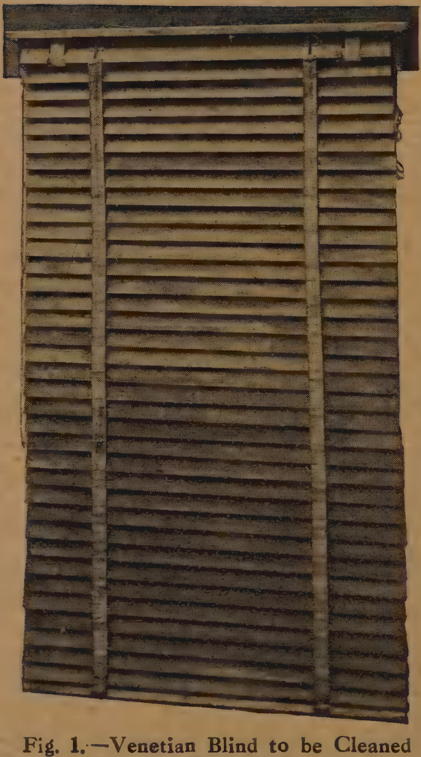


Fig. 1.—Venetian Blind to be Cleaned and Re-corded

First, the reversing cord at the left of the blind is removed from the two eyes in the next top lath, and then the two knots are cut off the ends of the cords under the bottom lath. A pull, as if to draw up the blind, will bring the cords right out. Next, the laths are taken out and the ladder tapes removed by prising up the $\frac{3}{8}$-in. tacks with a small screwdriver (see Fig. 4). The two sling tapes also are taken out, all to be washed clean with soap and water in the ordinary way and ironed.

Cleaning the Laths.—The best way to wash the laths is to place them together in a bucket and scrub all the edges first (see Fig. 2), then the sides, and put out to drain, finally polishing off with a dry rag. Even when they are to be painted they must be washed and thoroughly dried. Venetian blind paint may be bought ready mixed; but the very quick-drying enamels should be avoided, as they are apt to chip off. Fig. 3 shows a makeshift horse for drying painted laths. It consists of two pairs of sticks nailed slightly, crossed at the top ends, and another nailed to the two back legs. The narrow lath simply rests in the V places of the crossed sticks so that either end may be raised for putting on the laths.

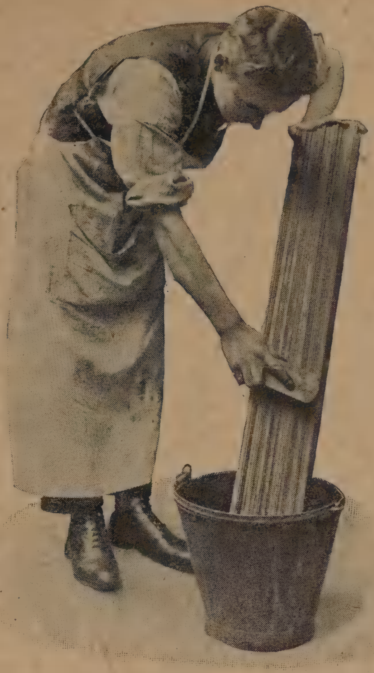


Fig. 2.—Method of Washing Blind Laths

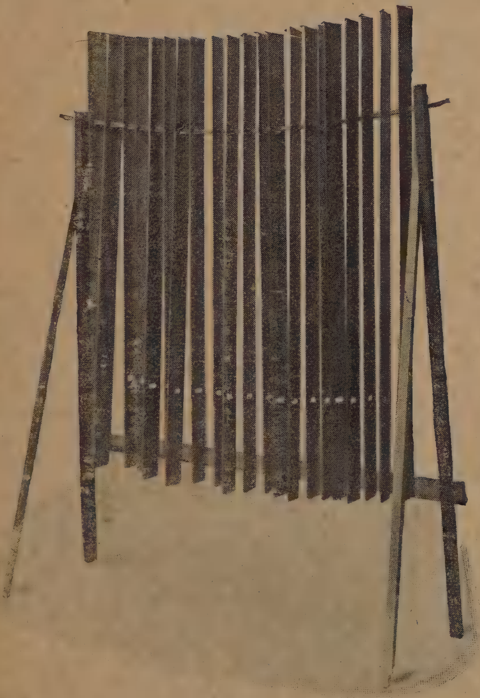


Fig. 3.—Method of Drying Painted Laths

A tradesman's method of re-painting blind laths is first to soften the old paint by applying a solution of equal parts of pearlash and soda dissolved in hot water, and rubbed on with a grass or any worn-out paint brush. When the paint has softened, scrape it off or rub off with the brush. Rinse with plenty of clean water, and finally give a wash of weak vinegar to counteract any alkali that may be left. One of the special paint removers might prove more suitable. Give the laths a coat of weak glue-size, one coat of sharp paint, and one coat of church oak varnish, to which a little of the colour should be added. If the green is bought ground stiff in oil, thin it down with a liquid composed of terebene drier, ½ part; japan gold-size, 1 part; and turpentine, 4 parts. A semi-gloss may be obtained by adding varnish to some of the paint and giving this for a finishing coat. The varnish must be of good, hard-drying quality.

New venetian blinds are painted in the following manner: remove all dust from the laths with a brush, and give the knots two thin coats of patent knotting. Beat

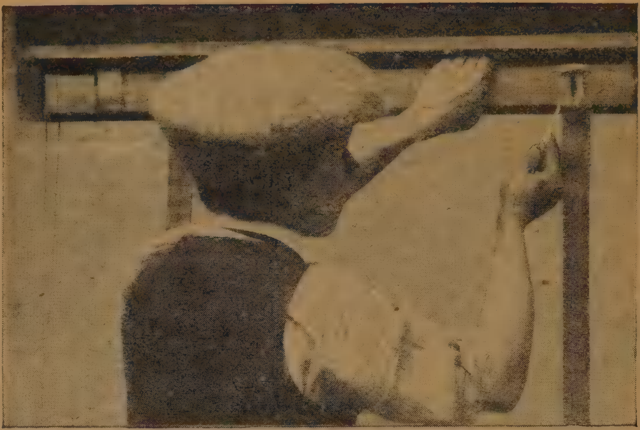


Fig. 4.—Untacking Blind Ladder Tapes

up stiff in a pot 2 lb. of genuine white-lead ground in oil with 4 oz. of patent driers, using linseed oil and turpentine in equal proportion as thinners. Thin one-fourth of this with linseed oil for the priming coat. Add to the remaining three-fourths the pigments for staining the colour with which it is intended to finish. Take about two-thirds, and thin with one-third linseed oil and two-thirds turpentine for the second and third coats; the remaining colour should be thinned out with good carriage varnish for the final coat. Any colour pigments required should be bought ground in oil, and not in the form of powder. Strain the paints through fine muslin before using; allow plenty of time to dry between the successive coats, and rub down lightly with fine glasspaper.

A much quicker method is to use colour mixed with spirit varnish, but the work done in this way does not stand so well as by the method described in the preceding paragraph.

Pine laths are often finished simply with size and varnish, the latter alone imparting a sufficient tone. For a more pronounced colour, yellow ochre or lemon chrome may be mixed with the size; for walnut, add vandyke brown; for mahogany, add burnt sienna.

The varnish green with which venetian blind laths are coated is made of ground mineral green, 2 parts; white lead, 5 parts; with turpentine enough to mix. Then add 7 parts of turpentine varnish. Mix the other ingredients before adding the varnish.

A special combined paint and varnish for venetian blinds is made by most manu-

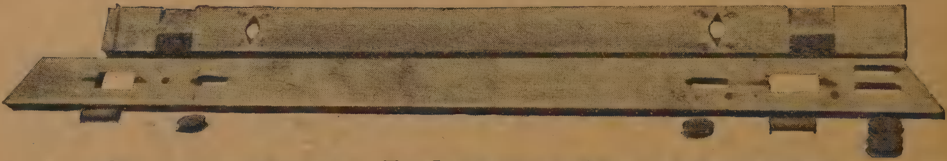


Fig. 5.—Top Side of Two Top Laths with Pulleys and Rollers Removed

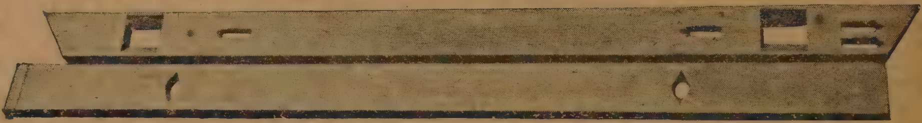


Fig. 6.—Under Side of the Two Laths

Fig. 7.—Top Lath with Pulleys, Rollers, and Check

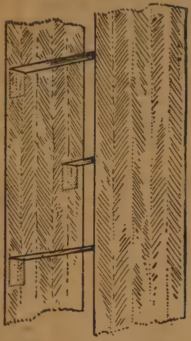


Fig. 8.—Woven Ladder Tape

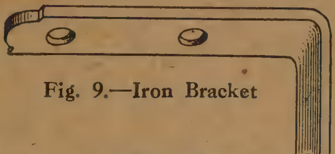


Fig. 9.—Iron Bracket

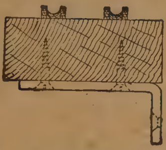
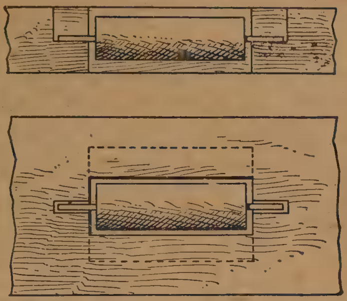


Fig. 10.—Head of Blind Supported on Brackets



Figs. 11 and 12.—Section and Plan Showing Mounted Tape Roller

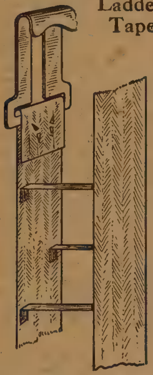


Fig. 13.—Tape on Kemp's Fitting

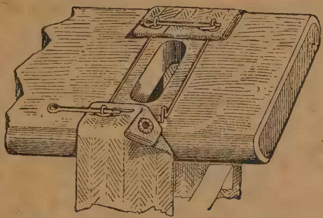


Fig. 14.—Tape Attachment: Tidmarsh's Method

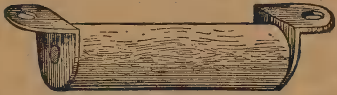


Fig. 16.—"Transenna' Tape Roller

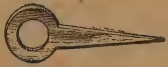


Fig. 15.—Venetian Driving Eye

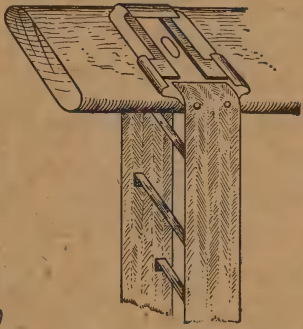
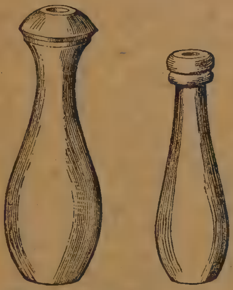


Fig. 21.—Tape Attachment: Kemp's Method



Figs. 17 and 18.—Cord Holders

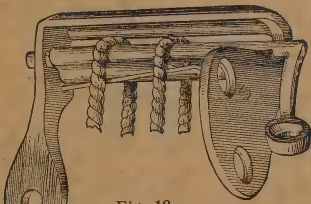


Fig. 19

Figs. 19 and 20.—Tidmarsh Check Actions

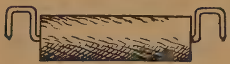


Fig. 22.—Tape Roller with Hooks

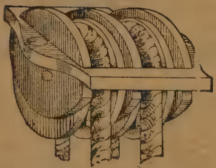


Fig. 23.—"Transenna" Pulley

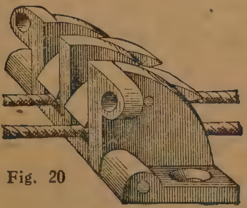
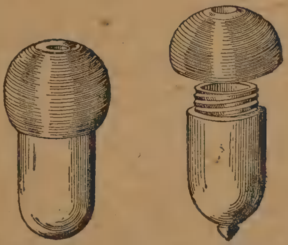


Fig. 20



Figs. 24 and 25.—Cord Holders

facturers, the work only requiring one coat, which gives a hard, enamel-like surface at a very trifling cost.

The Top Lath.—This has four wood pulleys and two rollers. If these do not all run quite freely remove the pulleys by drawing out the pins and the rollers by pushing up, and then clean them and oil them. Fig. 5 shows the upper side of the top and next top lath. Fig. 6 shows the under side of the same laths. Fig. 7 shows the top lath complete with pulleys, rollers, and check movement added. Figs. 8 to 25 illustrate various fittings, etc. Fig. 26 shows the check in position for checking the cords. The ladder tapes must be tacked in place exactly as before on the upper side of the next top lath, and the sling tapes put on the rollers and re-tacked as before on the under side of the same lath.

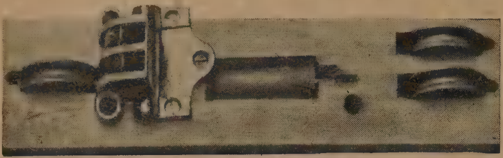


Fig. 26.—Check in Position for Checking Cords

In replacing the laths, the bottom one (the heaviest and containing two small holes) is put in first to keep the tapes apart; then the others are replaced in the manner shown by Fig. 27, thrusting the end forward to allow the other end to be drawn back in the right-hand tape. See that the rungs of the tape are alternately left and right of the slots in the laths.

Re-cording.—The photographs illustrate quite an average size blind (6 ft. by 3 ft.), and in measuring for new cord this takes 2 yd. through each of the tapes, 1 yd. above the top lath and 2 yd. of pull cord—total, 7 yd., all in one length. The reversing cord is 2 yd. long, and the check cord 1 yd. long. The two ends of the long length are threaded up at the right of the two pulleys, through the check movement, and down at the left of the pulleys over the lath slots, through which the ends must be threaded,

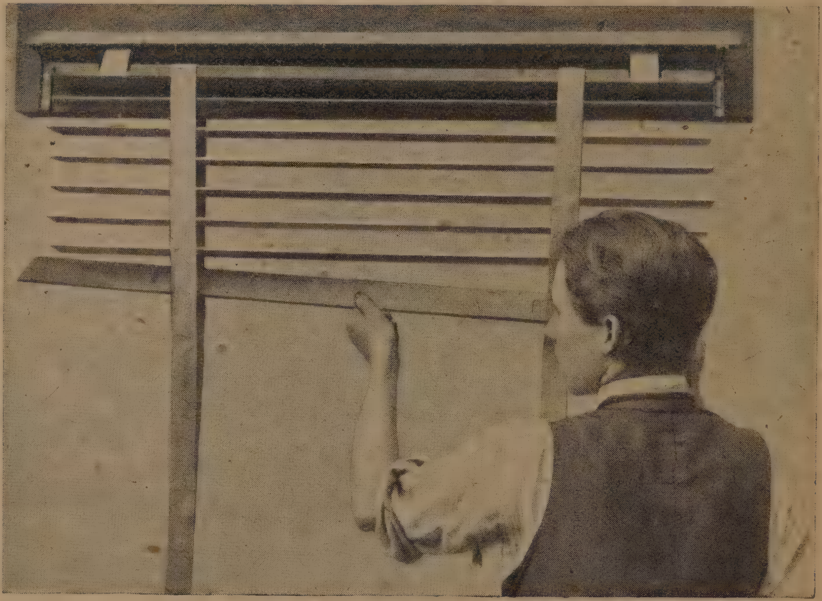


Fig. 27.—Replacing Blind Laths

coming out at the small hole at the lower stitched end of the ladder tapes, under the bottom lath. Two light metal terminals are put on the cords, which are then knotted at the ends.

The blind is then drawn up and let down a few times, retaining hold of the pull cord to get the blind quite level; then it is gently let right down and the cord knotted at A, Fig. 28. This illustration also shows the reversing cord and the single check cord. To draw the blind up, the knotted loop is pulled, the check cord being pulled to retain it in any required position (see Fig. 29). The way the cords are checked is shown in Fig. 30. Venetian blind cord only should be used, this being especially made for the purpose and having the proper strength and thickness. When new tapes are required, the old ones should be carefully measured up and 9 in. allowed for the slings. The tapes, cord, pulleys, checks, terminals, etc. (see Figs. 8 to 25, on p. 243) can be bought at most furnishing, drapery or hardware stores, though as a general rule new laths, which are seldom required, can only be obtained from a blind-maker.

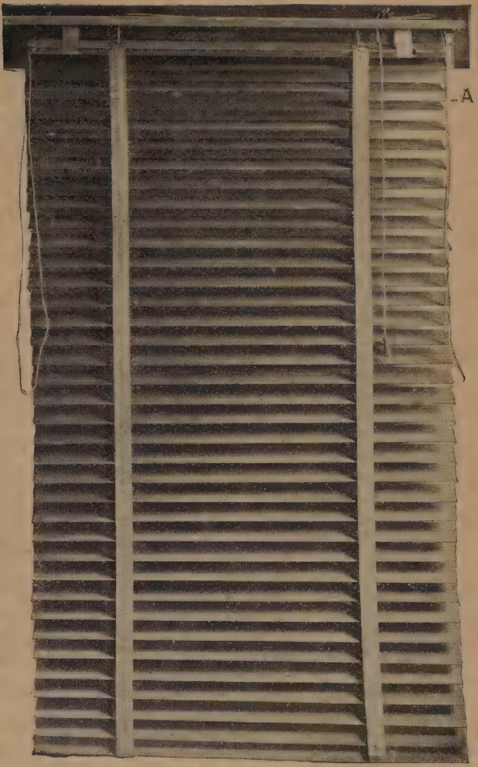


Fig. 28

Fig. 28.—Renovated Blind with Reversing Cord and Single Check Cord

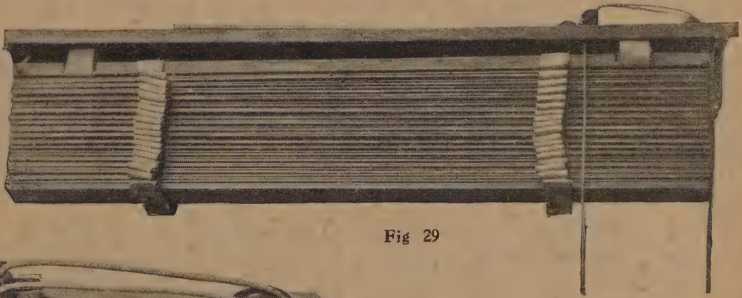


Fig 29

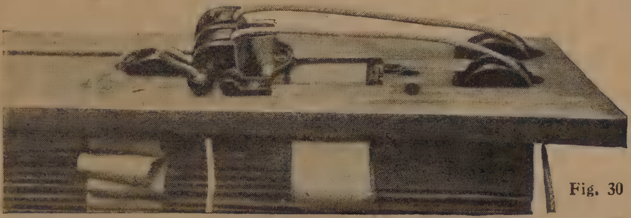


Fig. 30

Fig. 29.—Blind Checked and Retained

Fig. 30.—Cord-checking Arrangement

Hot-water-system and Range-boiler Troubles

THE hot-water system in connection with the kitchen range, consisting chiefly of a pair of circulating pipes extending from the range boiler to a hot-water storage tank, usually does its work silently, and if any noises are heard they are considered a good cause for alarm. Sometimes the noises are of such a character as to be very alarming; but, in any case, the occurrence of noise makes it requisite that something be done immediately to put an end to it.

Noises Caused by Generation of Steam.—The commonest cause of noise is generation of steam in the boiler, and the question of how steam comes to be formed there can be profitably considered, for once the cause is known a remedy is more easily found. It will be understood that if steam is at all freely formed in a confined space like a range boiler, and its escape is hampered by its having to pass through a great length of pipe with bends, etc. obstructing its free passage, it has to exert some force in making an exit, and this is accompanied by noise. If steam can escape freely there is little or no noise occasioned, but if escape is retarded the steam is delayed long enough to get an increased pressure, and its ultimate escape is effected with some violence. It may be said here that, alarming as the noises sometimes are, the writer has never known the conditions to be really dangerous. Of course, the noise indicates force, but it is not found to be sufficient to do any harm. Before a dangerous condition is reached the noise is beyond bearing, and compels attention.

The common cause of steam generation in a kitchen boiler is a retarded circulation, this being brought about by a stoppage in the pipes. It must be understood that when the pipes are clear the circulation is so free and swift that almost as soon as the water is in the boiler it is out again. There may be only a very short time between the water entering the boiler from the return pipe and leaving it again up the flow pipe, as just stated, but the period is, of course, long enough for the temperature of the water to be considerably raised. On an average, the water may have an increase in heat of perhaps 70° F. in once passing through the boiler, and if after a sufficient lapse of time the same water should pass through again, it may have a further rise of 40°, but even this increase of heat and lapse of time would not produce steam. If, however, the pipes are choked from any cause, then the circulation is necessarily slower, the water is longer in getting through the boiler, and in bad cases it may even reach boiling point before its exit. This is the condition under which noises occur.

The noises produced by steam, then, are those due to local boiling, some water in the boiler reaching boiling point, although the water in other parts of the apparatus may be nowhere near this temperature. The cause being a stoppage in the pipes, it naturally follows that the steam has a difficulty in getting away, for whatever interferes with the free circulation of water up the flow pipe will also interfere with the free passage of steam.

Noise and Stoppage Caused by Lime-incrusted Pipes.—The most frequent cause of partial stoppage of hot-water pipes is the incrustation of lime deposit, this, of course, being confined to hard-water districts. When there is a complaint of noises in pipes the two points to be considered are (1) Does it occur soon after the fire is lighted, or only after the contents of the boiler have had time to get hot ? (2) Has the trouble come on gradually ? If the noise does not occur until after the water is hot, then there is every likelihood that the pipes, particularly the flow pipe, are choked with lime deposit. In instances where the trouble is said to have come on suddenly, the stoppage may be due to a fall of scale in one of the pipes. Such is sometimes the case when it is said that the noise has only been heard since some work was done in the house, the workmen having possibly hammered or shaken the pipes. Collections of scale, if they exist, are nearly always found at bends or elbows at the foot or lower ends of vertical pipes.

When pipes are choked with incrusted lime deposit there is not, unfortunately, any simple remedy. They have to be cleared, and this necessitates taking them out, and when taken out the common experience is that it is just as cheap to put in new pipes as to spend time in clearing the choked ones. As a rule, the lime can only be removed by heating and hammering the pipe, a slow and imperfect process.

Noises occurring before Apparatus is Hot.—The "noises in pipes" that are less understood than the foregoing are those that occur before the water is hot, and are in no way due to steam. These occur within a few minutes of lighting the fire, and the writer experienced one case in which the noises were distinct before the wood of a newly lighted fire had burned through—that is, within about five minutes of putting match to paper, starting all cold. This is one of the most puzzling of noise troubles, it being so difficult to think of any noise-producing force that could come into action before the water is warm, in cases where it is known that the pipes are clear. The writer had an opportunity to investigate thoroughly an instance such as this, and the first thing to be discovered was that the noise ceased if the boiler was opened and carefully cleaned out. Only a small quantity of sandy deposit was found, but this was carefully removed and the noise was stopped. It reappeared, however, about four months afterwards, and was again cured by carefully cleaning the boiler. The question then arose whether the existence of the sandy deposit could cause the noise, for the quantity was small, and the wonder would be why, if this caused the noise, the trouble was not much commoner and more often heard of. Experiment was then made with sand on the perfectly flat bottoms of glass vessels containing water, and a remarkable action was discovered. The sand was about $\frac{3}{16}$ in. thick, the water 6 in. deep, and almost immediately after heat was applied beneath the vessel there occurred noises accompanied by distinct vibrations. It was seen that the sand in places rose in little hills, which appeared to burst, and as this happened the noise and vibration were experienced.

Since the foregoing experiment was made the writer has found that in every instance of noises being heard in range boilers before the water has reached a high temperature, the boiler had a flat bottom and there was loose, sandy deposit in it. The trouble is not experienced with boilers having arched flues formed in the bottom plate, as the loose sandy material does not rest in a layer on the arched surface ; neither does the trouble appear with any kind of boiler if the deposit is incrusted on the surface and not loose and fine. The remedy for this trouble is either to clean the sandy deposit out of the boiler frequently, so that the quantity is never enough to cause noise, or to change the boiler for one having an arched-flue bottom plate.

Discoloured Water in Hot-water Apparatus.—It may be accepted as a common rule that with a domestic hot-water supply apparatus having an iron boiler, iron pipes and tank, trouble by rust is not expected if the water is "hard" (having lime in solution in moderate or full degree), while rusting, and discoloration of the water by rust are more or less certain if the water is soft (deficient in, or practically without, lime in solution). It would entail a long explanation, rather out of place here, to show that the presence of lime, although in solution in the water, brings about immunity from rusting, but such is the case with certain qualifications. In consequence of this, it will be found that in those areas in Great Britain served with soft water the domestic hot-water installations are carried out with copper boilers, lead or copper pipes, copper cylinders, etc., while in hard water districts, largely confined to the southern half of England, the water is hard, and iron boilers, iron pipes and tanks are freely used. The iron pipes are sometimes galvanised, but by no means always, and the water shows no indications of being discoloured or otherwise affected by the iron.

Rusting and discoloration occasionally occur in an apparatus of iron pipes served entirely with hard water. There are thousands of such apparatus giving no trouble whatever, yet sometimes the rust appears, and the fitter or the user is at a loss to know what to do.

As to the cause of this it may first be explained that the rusting of iron does not occur very freely when the water in contact is hard, and, as stated, the presence of the lime accounts for this. But the fact that the water is of this nature does not entirely prevent rusting unless it is heated and frequently changed. The accepted explanation is that when the apparatus is newly erected and first charged with water, it is put into regular use at once or very soon after it is finished, when the heating of the water brings about a deposition of lime, and so soon as this occurs protection against rusting is assured. In other words, when hard water is heated lime is deposited, and although the quantity may be exceedingly small, yet the existence of the deposited lime on the inner surfaces of the boiler and pipes is sufficient to prevent, or at least delay, the rusting until the heating of successive quantities of water makes the deposit afford full and certain protection. Briefly, if the new iron surfaces are quickly coated with lime, however slightly, rusting does not start, and as each quantity of water adds to the coating of lime no trouble by rusting can take place.

In the rather unusual case of rusting occurring with hard water, it is found to be with new or nearly new installations which have been left full of water, and *unused* for some time. A house may be newly built or have a new apparatus put into it, this being left full of water, and occupation by owner or tenant does not take place for two or three months. If there is no caretaker and no one makes use of the kitchen range fire which heats the water, trouble by rust is nearly sure to occur, due to the water (which may be quite hard) lying stagnant and unheated in iron pipes which have no protective coating whatever in them.

The writer has had experience of this on several occasions, one instance being in his own house, and with which some careful investigations were made. It was a country house where the water was pumped from a well, and the hardness of the water rather exceeded that of the waters usually served from a water company's mains. The hot-water apparatus had to be completed some time before the kitchen could be occupied, and when the whole came into use the water was unfit for anything by reason of its discoloration by rust. This trouble did not disappear after the first water was drawn, but continued day after day. Feeling that the hardness of the water must effect a cure in the end, nothing was done except to heat and use the water as freely as possible, and after a time it was seen that the colour was lessening. It took five months to effect a cure, after which the water always remained clear. Of course, few people would care to wait so long, and in this case it was only done to see if the trouble would cure itself.

The following means of hastening the cure when found necessary can be recommended from practical experience.

Realising that lime is antagonistic to the rusting process, it is found that a stop can be effected by lime-whiting the inside of the boiler and pipes. To do this ordinary builder's quicklime is obtained, and this is slaked with water in the usual way. Hot water is then prepared, a little size having been melted in it to act as a fixative for the wash, and this water is added to the lime, in a tub or other vessel, in sufficient quantity to make it into a thin cream. The hot-water apparatus having been emptied, a means is provided to pour in this mixture at the top so as to let it run through and coat every part, after which the coating is allowed to dry. One coat is considered sufficient, but if the mixture can be run through again (after the first coat has dried) it makes doubly sure. When finally dry, water is run in as usual.

The effect of the coating of lime is to artificially " fur " the pipes and boiler in a way that will stop the rusting long enough to let the natural furring do its protective work, and, so far, this plan has been found quite successful. This remedy is of little or no value when the rusting is due to soft water being used. In other words, it is not a permanent remedy unless there is hard water to follow it up and perfect it.

A Serious Fault—Terminating the Flow or Hot Pipe at too Low a Point in the Storage Tank or Cylinder.— This may be considered as the most common of all the faulty details to be found in the apparatus designed to supply hot water at taps. Taking what is known as the tank system of apparatus, in which the storage tank is at or near the top of the house, it must be assumed that most hot-water fitters fail to recognise the important duty the flow-pipe is intended to perform and that they look upon this pipe only as a means of delivering hot water into the tank, and nothing else. The flow-pipe is certainly the one that carries the heated water from the boiler to the tank, and as such it performs a necessary part ; but this is not the only or the chief function of the pipe, there being one other, this being the one that is usually overlooked.

There is an impression that the flow-pipe has to terminate in the tank some few inches up from the bottom to ensure getting a proper circulation. This idea is not correct, for a perfectly good circulation can be had with the flow-pipe flush with the bottom of the tank. The real purpose that the high termination of the flow-pipe is intended to serve is to permit of the hottest water being drawn at the taps.

When a hot tap is opened the flow-pipe becomes a draw-off pipe, hot water coming down it from the storage tank. The storage tank is provided to store hot water for use when required, and the flow-pipe is the means or route by which the stored water travels down to a tap when it is opened. This is what appears to be so generally overlooked, for the flow-pipe is nearly always terminated too low. If the flow-pipe does not reach up to the top part of the tank then the top water cannot be drawn. Cold water enters the tank as fast as the hot taps withdraw it, consequently the tank is always full, and the top water is undisturbed if the flow-pipe does not reach up to it. The seriousness of this lies in the fact that the first water heated gathers up at the top of the tank, while at other times the hottest water is always at the top of the tank, yet the flow-pipe—the means of drawing the water—does not reach to the top of the tank. It might be rightly said in very many cases that whenever the water is heated up the first half hour is devoted to heating water that cannot afterwards be drawn, while at later times in the day there is half a tankful of hot water—the best half—that cannot be had at the taps.

Fig. 1 shows how the flow-pipe should terminate high in the tank. The solid lines show one way of doing this, while the dotted lines show alternative ways. Either one is as good as the other, for all that has to be ensured is that the pipe terminates up where the hot water is, little or much, when there is any at all. It may be added that the common practice is to terminate this pipe about half-way up the tank, sometimes a little higher, oftentimes lower; only very rarely does it reach high enough.

Allowing the Cold Water to Mingle with the Hot.—Whenever hot water is drawn from a hot tap there is a simultaneous inflow of cold water into the apparatus somewhere, and the engineer has to make his cold water connection so that the inflowing cold water will not become mixed with the hot. The cold water should lie on the bottom of the tank, or form a stratum in the lower part, with the hot water resting above it, the two not mingling to more than a small extent. It is not possible to draw hot water without cold water coming in at the same time, neither can the two waters be kept separate by plates or divisions in the tank. They have to rub shoulders, so to speak, in the same storage vessel, and it must be arranged that they do not mix. The best that can be done to prevent mixing is to cause the water to be delivered horizontally on the bottom of the tank, the illustration, Fig. 2, showing how this is effected. The cold supply pipe may enter the side of the tank, close to the bottom, as shown by dotted line, or it may enter the bottom of the tank, vertically, as shown by solid line. In this latter case the important detail—so often omitted—is to put a T-piece or elbow, or some form of spreader, on to the cold connection, inside the tank, which will deliver the water horizontally. Fig. 3 is given to show what happens if this is not done, the cold water when it enters boring up and mixing with the hot. This must be prevented.

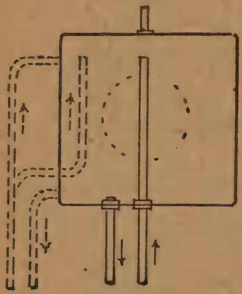


Fig. 1.—Termination of Flow-pipe High in the Tank

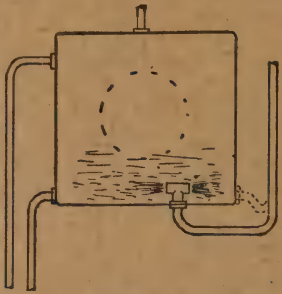


Fig. 2.—Cold Water Entering Tank Horizontally at the Bottom: Correct

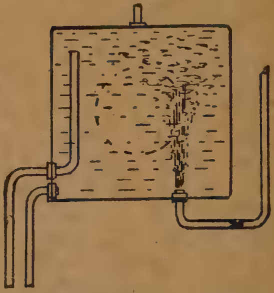


Fig. 3.—Cold Water Entering Tank Vertically: Incorrect

Storage Tank too Large.—In so many houses the hot-water supply is more or less a failure because the proportions of the boiler and the storage tank or cylinder are incorrect. Not infrequently a boiler may be suited for the requirements of the house, but is over-loaded and made incapable by too large a storage tank. There has been some idea that a large tank ensures a large supply of hot water, instead of which it makes the boiler appear to be a slow heater by delaying the yield of hot water. There may be a greater bulk when it is hot, but this usually comes later than is expected or required.

It may be said that the average house up to the old £50 rental (London value) can have its wants met by a 25-gal. storage tank; up to £70 rental, 30 gals.; larger houses, having one bathroom only, 35 gals.; when there are two bathrooms both of which may sometimes be used at once, the storage will have to be 50 to 60 gals.; in very large establishments, the last-mentioned figure may have to be exceeded. What we are concerned with now is the existence of storage tanks (or cylinders) of too large a size in houses of the lesser rentals, and it is intended to show how these tanks may be reduced (to suit the boilers) at a quite trifling expense without disconnecting them.

The following brief table gives the maximum capacities of tanks or cylinders which boilers of certain sizes give best results with.

Fire Width	*Boiler Shape*	*Tank or Cylinder Capacity*
9 in.	Arch-flue block	20 to 23 gals.
9 in.	Boot	28 or 30 gals.
10 in.	A.F.B.	25 gals.
10 in.	Boot	32 gals.
11 in.	A.F.B.	30 or 32 gals.
11 in.	Boot	38 or 40 gals.

If the proportions of boiler to tank differ to the above the question arises whether the boiler power requires increasing (by substituting a boot boiler for the square boiler) or whether the storage capacity should be decreased. As too large a storage is a common fault it frequently happens that it may be decreased with advantage and Fig. 4 shows how this can be done.

The illustration shows a cylinder, but the principle applies in exactly the same way to a square tank, and all that has to be done is to raise the termination of the return pipe. Wherever the return pipe terminates in a tank or cylinder is equivalent to being the bottom of the tank (or cylinder). If, for instance, a 50-gal. cylinder has its return pipe terminate half way up it, the actual working capacity of that cylinder will be 25 gals. It will be in effect a 25-gal. cylinder, although by measurement it is of 50-gal. size. Fig. 4 is intended to show a 40 gal. reduced to 25 gal., the return being carried up three-eighths its height from the bottom. The part above the end of the return will be active, the part below inactive. The latter may be considered as part of the cold supply, for it will act as such and have no ill effect on, or in any way prejudice, the active part above.

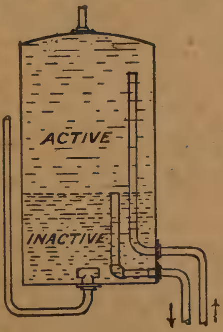


Fig. 4.—Working Capacity of Storage Cylinder Reduced by Lengthening Return Pipe

It will be understood that the alteration consists in adding a piece on to the existing return connection, inside the tank or cylinder. If the return is connected to the one side of the vessel then an elbow and short stand-pipe is necessary, as shown. It the return is connected to the bottom plate, a stand-pipe only is necessary.

REPAIRING HOLES IN HOT-WATER CYLINDERS

Practically the only way in which a galvanised-iron hot-water tank or cylinder " wears out " is by the formation of rust holes, these starting as rust spots which presently leak. The words " wears out " are distinguished with inverted commas because this trouble so often appears with comparatively new tanks or cylinders—more with cylinders than with tanks—and it is found that the rest of the plate is almost or quite like new. It is almost always the bottom plate that suffers, and the occurrence is so common and so generally recognised that makers now give prices for cylinders with the bottom plates thicker than the sides, or with the bottom plates coated internally with a special composition. The writer has found that a little portland cement floated in is as good a preventive as anything.

When a leaky spot appears in the bottom plate of a cylinder, it is considered difficult of repair because soldering on an under surface is not easy, and may require the cylinder to be taken down. The method of repair adopted by the writer can be put into practice by any amateur in a few minutes if the materials are ready.

A bolt of about $\frac{3}{16}$ in. thickness, 1 in. long, screwed nearly its whole length and having a T or cross-head, as Fig. 5, is required. On it must be an iron washer of 1 in. diameter with centre hole no larger than the bolt, and a nut. Red- and white-lead putty with hemp is used as packing material.

When the cylinder has been emptied of water, a bradawl, or the tang of a file, is pushed through the rust spot, which will be found to be a weak, soft place, and then the hole is enlarged by filing until it is a slot (see Fig. 6) which will allow the head of the bolt to pass through. The bolt head is then put through and given a quarter turn, which will bring the head crossways to the hole. The washer, coated with the packing material, is then slipped up the bolt to cover the hole, and this is followed by the nut to tighten it. This makes a sound repair, but there is one difficulty if something is not done to obviate it. As the nut is being screwed up, something is required to indicate whether the bolt itself is being turned round, for if it should turn, the cross-head may not lie properly across the slotted hole. A simple indicator is to file a notch across the other end, the tail, of the bolt, so that by keeping an eye on this notch while the nut is being screwed up it will be seen if the head is remaining in position. The nut ought to run up rather easily on this account.

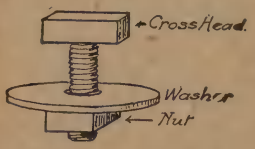


Fig. 5.—Washer and Nut on T-headed Bolt

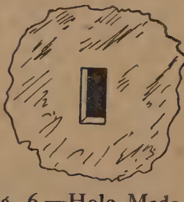


Fig. 6.—Hole Made in Hot-water Cylinder

WHEN THE SIDE BOILER OF THE RANGE GIVES COLD INSTEAD OF HOT WATER

There are, of course, hundreds of thousands of houses which do not have a hot-water apparatus heated by a back (high-pressure or bath) boiler in the range; the range has an oven one side of the fire and a boiler at the other. The boiler is called a low-pressure one, because it has a loose lid; and it is common practice for it to be automatically supplied with water by a feed cistern (with ball valve) placed at the side or near by.

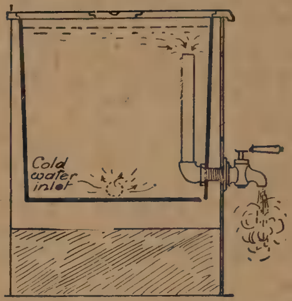


Fig. 7.—Side Boiler Altered to Correct a Fault

With all these boilers the tap, at the front, is near the bottom, while the cold supply or feed pipe is connected close to the bottom also; and it is only natural that, as water is drawn out of the tap, fresh cold water flows into it, and this cold water passes from hole to hole across the bottom of the boiler, scarcely disturbing the hot water at the top.

It is a fact that with thousands of these boilers it is not possible to draw one-half, or in some cases much more than one-fourth, of the hot water in them, unless the cold water is prevented from flowing in while drawing out the hot water.

With boilers of this kind, when automatically fed with cold water, the tap ought to be up near the top of the boiler. Its being located near the bottom is simply the result of following the style introduced by the earlier type of boiler, which was not self-supplied and which was not always full of water.

The remedy is to put an elbow and stand-pipe on to the tap, inside the boiler, as indicated in Fig. 7. It will be seen that this provides for drawing the top water, the hottest and best water, and all there is of it. An occasional difficulty lies in the fact that some taps are $\frac{5}{8}$ in., whereas $\frac{5}{8}$-in. elbows and pipe are not made. In such a case, the back-nut of the tap can possibly be taken off and soldered on to a $\frac{3}{4}$-in. elbow and then replaced.

CLEANING RANGE BOILERS

The quantity of lime that may accumulate in the bath boiler of a kitchen range in a moderately-hard-water district depends on how often the water is changed (that is to say, how much is used), and the kind of fire that is kept. On this account adjoining houses using the same water may have a quite different deposit of lime in their boilers. The best plan is to clean the boiler the first time in six months; its condition then will indicate how often it should be cleaned. Lime should not be allowed to become more than $\frac{1}{2}$ in. thick.

The cleaning is done as follows: First shut off the cold supply to the cylinder, either by closing the stop valve (if there is one) or by plugging the end of the pipe in the house cistern (a broom-handle usually serves this purpose). Now loosen the plug of the emptying pipe which comes from the boiler and run out the water.

Having emptied the apparatus remove the nuts or screws which secure the lid of the boiler and, when the boiler is open, commence removing the lime. There may be some lime lying loose, but what it is important to remove is the hard deposit encrusted on the plate, particularly around the arch at the front. This is where the deposit is thickest, and where the boiler can the soonest be injured by the existence of the deposit. A chisel will be needed to loosen the hard deposit.

When the hand is inserted be careful that the rough inner edge of the manhole does not cut the wrist, which should be protected. When the cleaning is finished, the lid must be replaced and the water turned on. The emptying plug must be secured before the water comes in; or, better, take the opportunity to put a loose-keyed cock there. A rubber ring is the simplest thing to use for re-jointing the manhole lid.

Re-enamelling a Bath

THE first essential is to remove the old enamel. Effect this with (1) a paint or varnish remover obtainable at a decorators' supply depot; (2) a mixture of half a bucketful of freshly-slaked limewash, 1 lb. to $1\frac{1}{2}$ lb. of washing soda, and a handful of rock ammonia rubbed on with a fibre brush and allowed to stay until the enamel is soft, repeating the application if necessary; (3) with a blow-lamp; or (4) by tapping with a small hammer, in any case soaking afterwards and freeing from grit. Should the enamel be in good condition it may suffice for some jobs simply to clean it down with hot strong soda water to remove all traces of grease, afterwards thoroughly rinsing in clean water; but the best results will not be obtained in this way. The metal having been laid bare can be coated with a high-quality bath enamel, the makers of which also sell a flat undercoating, two or three coats of which may be required to build up a really good surface, finishing with a flowing coat of the glossy enamel. Or, instead, mix one part of boiled oil with four parts of turpentine, and apply to the bath. Allow a day to dry, and then give two coats of paint made by mixing together 3 lb. of zinc white paint in paste, $\frac{1}{4}$ pint of pale gold size, and $\frac{1}{4}$ pint of pale copal varnish, all these being thoroughly well stirred, and thinned down as may be required with the best American turpentine. This dries hard with a good gloss and resists hot water. At least two days should be allowed between the application of the coats.

Re-upholstering a Couch

A COUCH forming part of a rather cheap suite is shown by Fig. 1. The seat had been covered with old newspapers and a piece of cretonne tacked over, and the bottom was fixed up, in a way, with leather belting (see Fig. 2). Such attempts at repairing are of very little use. There is a considerable amount of work in repairing this couch, but not so much that the home handyman need be afraid to tackle it. It must be understood that it is not going to be a first-class piece of work, but it will be quite as good as it need be. Whilst lying in the position shown by Fig. 2, the straps and webbing are stripped off (see Fig. 3) and the springs are cut from the canvas. The couch is then stood up for stripping off the stuffing of the seat, beginning under the scroll head (see Fig. 4) by untacking the leather cloth cover and the spring canvas. When the untacking is complete, the whole lot is lifted carefully away to avoid making a mess. Fig. 5 shows the couch with the seat stripped. For re-webbing, the couch is turned upside down. A piece of German web is required, $\frac{5}{8}$-in. webbing tacks, a knife and hammer. Begin the webbing at the foot end, four webs

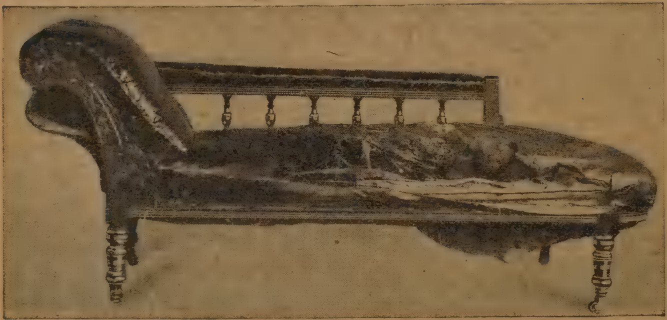


Fig. 1.—Couch in need of Re-upholstering

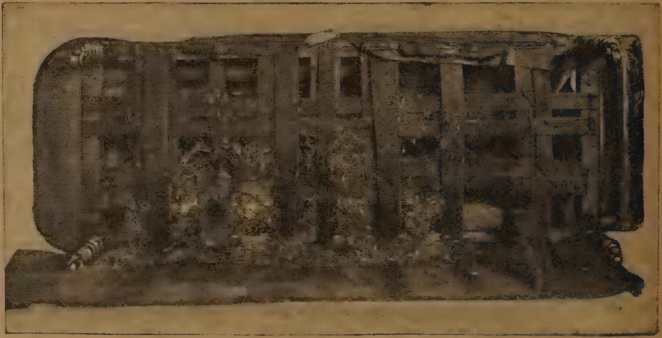


Fig. 2.—Bottom of Couch

being put lengthwise in two pairs. Fig. 6 shows work starting on the fourth web. The cross-webs are also put on in pairs, as in Fig. 7, which shows the stretching of the first of the last pair put on. In doing this work, it is usual to pull out the centre of the piece of web and work from both ends. Next the couch is stood up on its legs and the twelve springs placed in position in six pairs (see Fig. 8), the bottom coils being about 1½ in. from the front rail and the back row about 3 in. from the back rail. Then they are stitched. A piece of strong canvas is now cut the same size as the old spring canvas and tacked on in the same way (as indicated by the tack marks), first to the back rail and pulled over to the front, then to the foot end and the head rail. The springs are then worked into position and stitched as shown by Fig. 9.

Upon examining the stuffed and stitched "roll," the front is found to require renewing, but the foot end is fairly sound, so to save trouble it is cut off and tacked in place as before. As seen by the worn-out part, a new piece of canvas is required long enough to reach from the foot leg and pull out at the head rail, by 1 ft. wide. It is stitched to the spring canvas as the old one was. It is now the purpose to form a stuffed stitched "roll," following out the portion at the foot. To do this, the first thing is to put loops of string on the top side of the wood rail, fixed with tacks in the manner shown at A in Fig. 10, to pack the stuffing under as shown at B. In this case the stuffing was of wood fibre for the stitched edge, but new material is used instead of the old. It is packed under the loops in a close, firm and even roll, then more stuffing is put behind it, and the

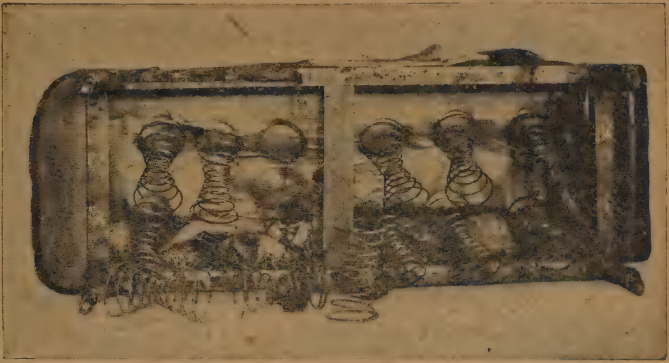


Fig. 3.—Straps and Webbing Stripped from Couch

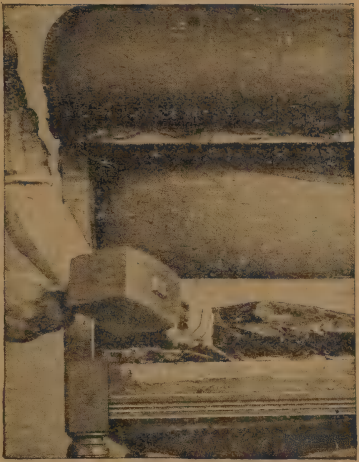


Fig. 4.—Untacking Couch Covering

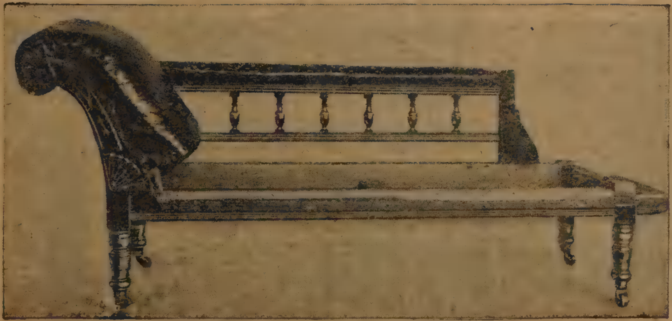


Fig. 5.—Couch with Seat Stripped

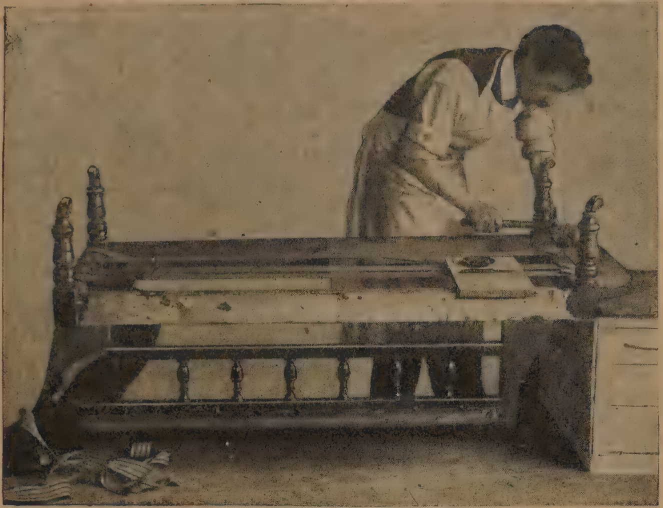


Fig. 6.—Tacking on Webbing

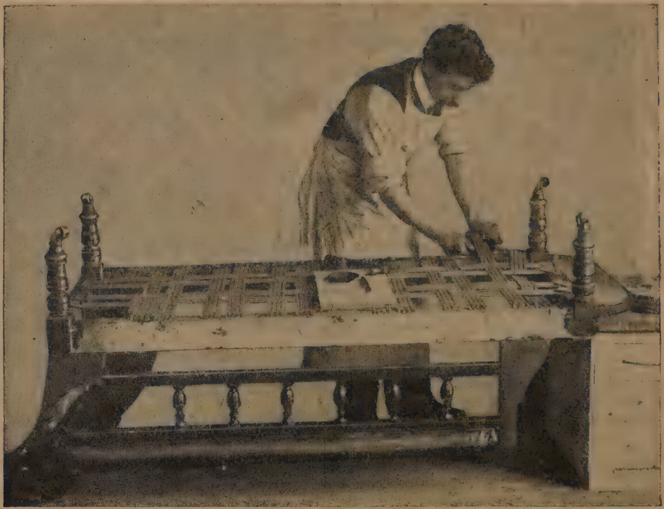


Fig. 7.—Cross Webbing

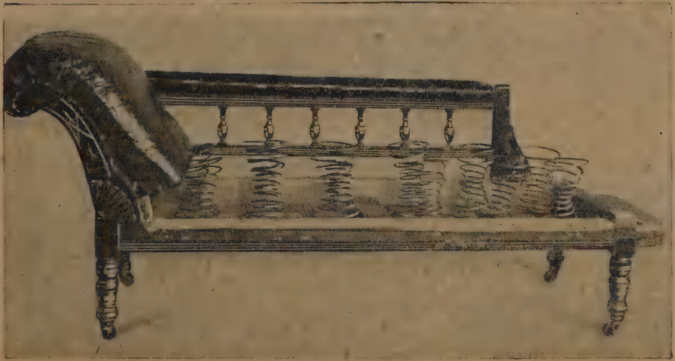


Fig. 8.—Springs in Position

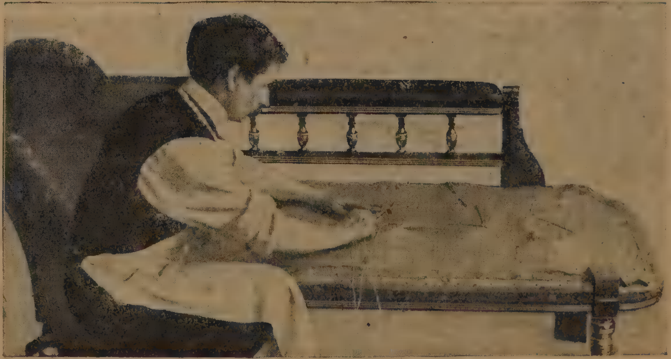


Fig. 9.—Stitching Springs to Canvas

new strip of canvas C is drawn over and the edge doubled in a little and tacked along the wood rail. The foot-end of the canvas is stitched; and pulled through at the head and tacked.

At this stage it is a moderately firm-stuffed edge, but too round and full; so it requires stitching as shown by Fig. 11. For this an upholsterer's 8-in. needle is used and stitching twine. The stitching is done as shown, the forepoint of the needle being thrust in at D, coming out at E, then the back point is thrust in at F and out at G; the cord is twined round the needle, and it is drawn out, pulling the stitch tight to form a "roll" nearly 1 in. in diameter.

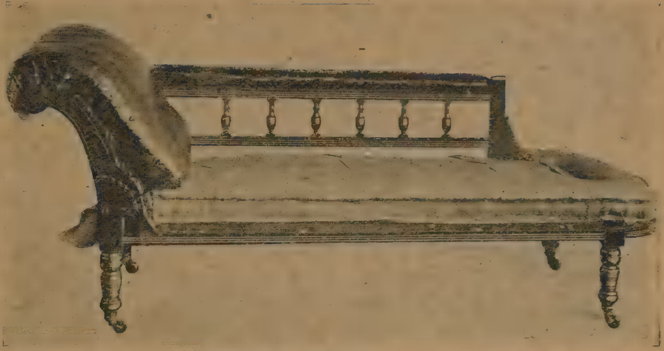


Fig. 12.—Work Ready for Second Stuffing

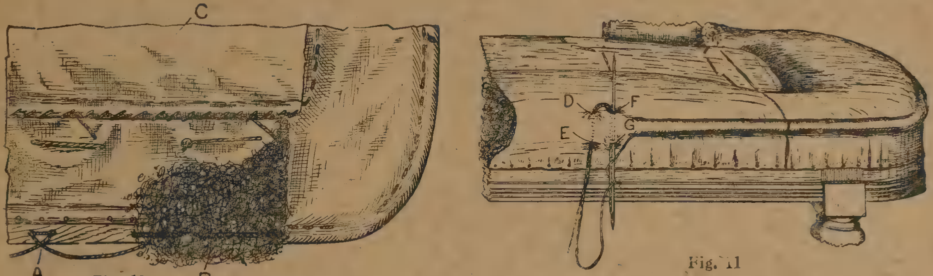


Fig. 10

Fig. 11

Figs. 10 and 11.—Forming Stuffed and Stitched Roll

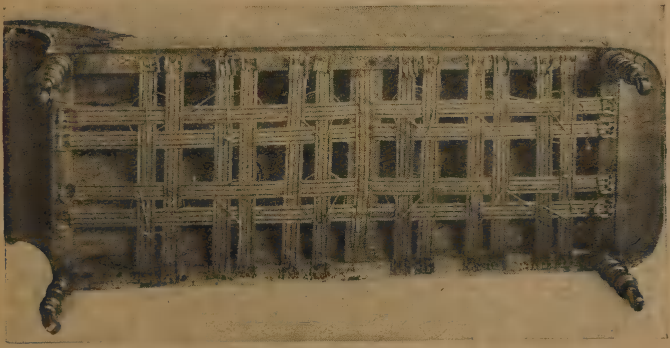


Fig. 13.—Under View of Couch Bottom

When this is done the couch is ready for the "second stuffing," see Fig. 12. Fig. 13 shows an under view of the couch at this stage. The second stuffing is of "rag flock," and requires to be beaten and teased out. This is the point at which the amateur worker is likely to go wrong, as some judgment is required to get it back evenly. A simple method is to make three chalk marks across the canvas, dividing the seat into four equal parts. Next, divide the stuffing into four equal parts. The foot portion is taken first and beaten out with the edge of a lath (about 3 ft. long and 2 in. wide and ½ in. thick) in such a manner as to chop it up. This will beat out the dust and make the material soft, so that it will not require much teasing. It is then replaced in its particular position. When the stuffing is all on, the old leather cloth cover is laid on the new, which is cut the same, but allowing a couple of inches over at the back and end edges to pull it; then it is placed over the flock and tacked first along the front edge. The tacks need not be driven home until the cover is found to be on correctly all over. The back edge is next tacked, pressing down the stuffing and drawing the cover as tight as possible; then the foot end, and, finally, the head. It is now well pressed down, and the hands should be drawn over it from end to end and across; after which it may be found necessary to pull out the tacks a few at a time to draw the cover down tighter and make the shape more even.

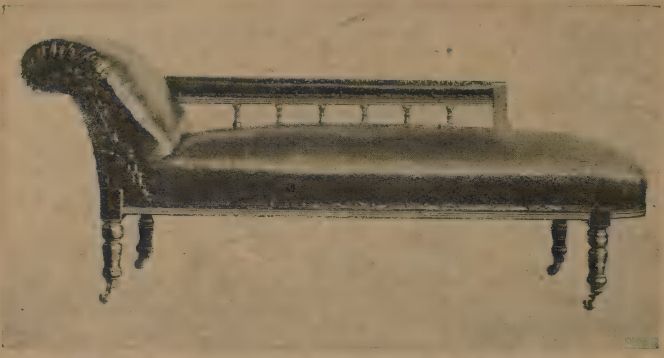


Fig. 14.—Couch Re-upholstered in Leather Cloth

The couch head and stuffed back rail have worn shabby, so the covers are taken off, new ones cut, and put on in the same way; the same applies to the covers at the back and under the scroll head. The surplus edges of the covers are then trimmed off with a knife and finished with banding and studs as in Fig. 14. Originally, the studs were put about 4 in. apart, but this time they are put less than 2 in. apart, which is a considerable improvement.

A cover of canvas put over the webbed bottom underneath completes the couch.

RE-WEBBING BOTTOM OF A LOOSE-CUSHION COUCH

The couch shown by Fig. 15 is of an old-fashioned type, of which there are still many about, because they were made to last a long time. In Fig. 16, the frame is of mahogany, the front serpentine-shaped rail being cross-veneered, and the workmanship is good. It is upholstered in hair-seating which also is a very durable material, but now out of fashion. When hair-seating becomes worn it gets very prickly, and the dust penetrates it easily; it is rather expensive to replace, so that the leather-cloth fabrics have superseded it to a large extent. Economy is shown in this couch by the stuffing being of white cotton flock. It is the first time the couch has needed repair for thirty years, and the broken-down webbed bottom can be repaired at home in a couple of hours.

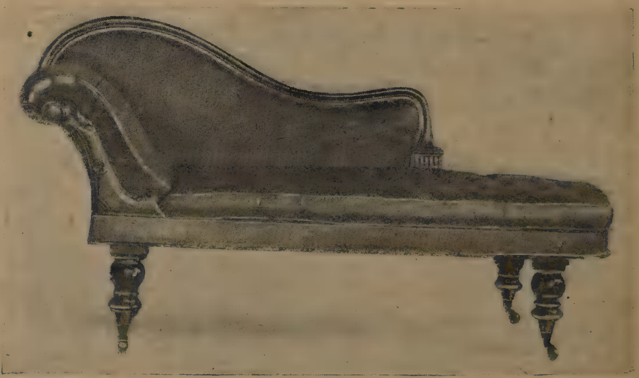


Fig. 15.—Loose-cushion Couch

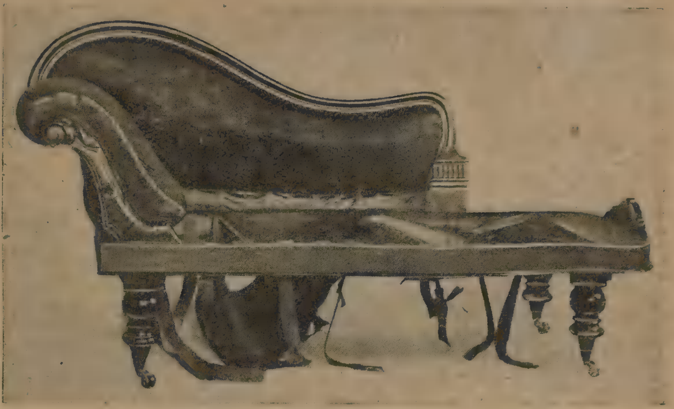


Fig. 16.—Couch Requiring Re-webbing

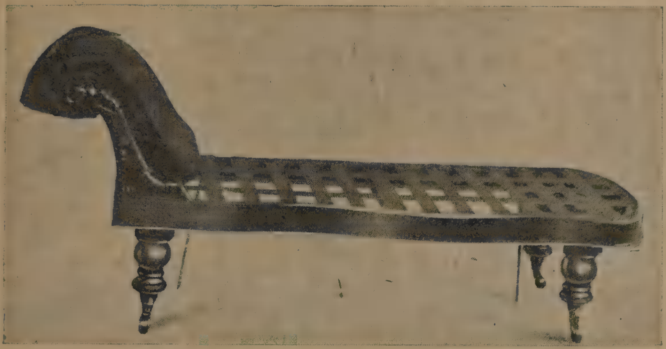


Fig. 17.—Webbed Bottom of Couch

First, the outside cover under the scroll head is untacked, except on the top edge; also the back cover is untacked to allow of taking out the screws that hold the back. The narrow end of the back is held by a coach-screw through the back seat rail. The carved ornament on the foot end is made to lift off. The re-webbing is begun from that end, stretching and tacking to the rail under the scroll head three webs lengthwise; then the cross webbing is tacked on, working from the front to the back; see Fig. 17, which shows the outside head cover pinned up out of the way for working. A cover of strong black linen is put over the webbing, the selvedge being turned over about $\frac{1}{2}$ in. on the back side of the back rail. It is stretched over and fixed with $\frac{3}{8}$-in. tacks $\frac{1}{2}$ in. from the front edge of the front and foot rail, then stretched and tacked to the rail under the head. The tacked front edge is covered with black gimp. The back and loose cushion are next replaced, to give the result shown in Fig. 15 on the preceding page.

Ebonising Oak Wood

The following is given as a good process for converting oak wood to artificial ebony: The blocks of wood are immersed for forty-eight hours in a warm saturated solution of alum, and sprinkled several times with a decoction of logwood. Smaller pieces may also be steeped for a certain length of time in the decoction, which is prepared in the following manner: One part of logwood of best quality is boiled with 10 parts of water; it is then filtered through linen, and the liquid evaporated at low temperature until its volume is reduced by one half. To every quart of this bath is added 10 to 15 drops of a saturated solution of soluble indigo entirely neutral in reaction. After having watered the blocks several times with this solution, the wood is rubbed with a saturated and filtered solution of verdigris in warm concentrated acetic acid, and this operation repeated until a dark colour of the desired intensity is obtained. Oak wood thus dyed looks like real ebony.

Making a Woodworker's Bench

THE importance of a rigid, well-made bench cannot be too greatly emphasised. When it is to be used only occasionally, and there is no regular workshop in which to keep it set up, the reader's preference will probably fall upon a portable bench as the one shown by Fig. 3, p. 2, of the present volume, and here described.

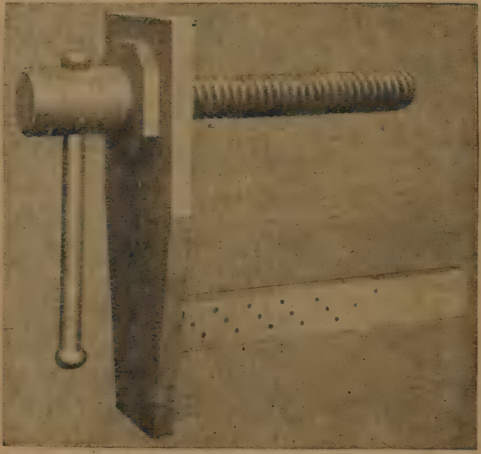


Fig. 1.—Screw and Cheek Detached from Bench

The elevations (see Figs. 3 and 4) show a good bench that is portable yet quite rigid when in use, and very easily erected or taken apart in a space of about five minutes. As shown by the reproduced photographs (Figs. 2 and 14), the legs are made in pairs connected at the bottom by two rails. The top (Fig. 6) is in one piece, with clamping bars across for the legs to fit between, and the vice and peg board are also separate pieces, placed in position after the other parts have been assembled.

The dimensions of the bench as given are, of course, only suggestive, and may be varied to suit special requirements, but the general proportions here given should be preserved. The height is important (as drawn, it is 2 ft. 6 in.), and naturally depends on the height of the workman, but it should be remembered that for planing and similar operations a good reach over the work is convenient.

The wood used may be red deal, but at least the first board of the top, and the vice cheek, should be of hardwood, such as beech or birch.

The legs are of 3-in. stuff; having been planed up square and true, they should be mortised as shown in Fig. 7. Each pair is connected together with rails, the top one being 3½ in. wide by 2 in. thick, and the bottom one 3 in. wide by 2 in. thick; and after gluing up and wedging the bottom rail, they should be further strengthened with a dowel pin or screw through each joint. All the joints must be good fits to ensure rigidity. The two pairs of legs are now mortised at the front and back to receive the movable rails, each mortise being 3½ in. long, and 7 in. from the bottom, on the outside of the

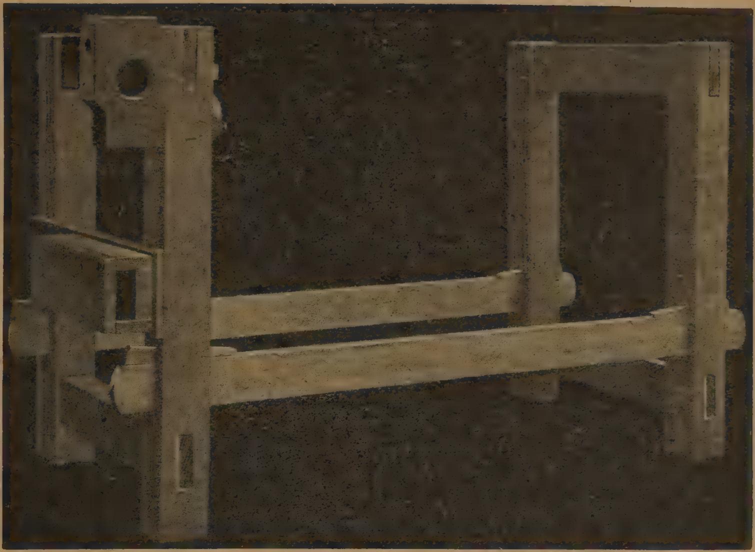
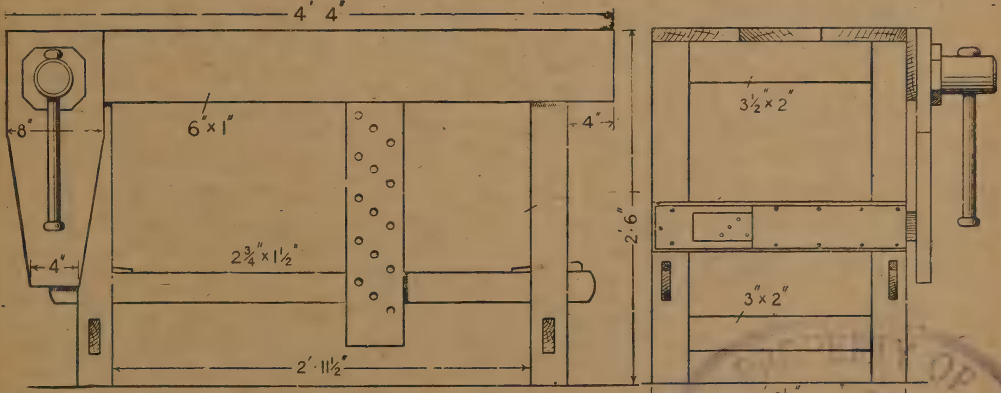


Fig. 2.—Complete Framework of Bench with Top and Screw Removed

leg, and $2\frac{3}{4}$ in. long and $7\frac{1}{2}$ in. from the bottom of the inside of the leg. This mortise allows the rail when in position to be held firm with a wedge, as shown in section by Fig. 8. The front and back rails are finished to $2\frac{3}{4}$ in. wide by $1\frac{1}{2}$ in. thick, and a bare-faced tenon (having a shoulder on one side only) $5\frac{1}{2}$ in. long should be worked on both ends of each; they should then be cut to fit the mortise in the leg, as shown in Fig. 8.

The top of the bench is 1 ft. $9\frac{1}{2}$ in. wide, and is made up of three boards grooved and tongued together, with three 5-in. clamping pieces screwed underneath, as shown in Fig. 6, so that they fit tight against the outside of the legs. Further to hold the legs in position, four small blocks should be fixed on the inside of the legs. The bench cheek is formed out of a 6-in. by 1-in. board, and is fixed to the edge of the top with stout screws, the holes being previously countersunk.

The bench screw is the part that requires the most careful fitting. The screw should be purchased complete with handle and a hardwood block or nut. The block needs to be cut to the shape shown by Fig. 12, and is then fitted to the top of the leg with two coach screws (see Fig. 14); the $\frac{1}{2}$-in. tenon in the block is intended to fit in a slot cut on the underside of the bench top to ensure rigidity. A



Figs. 3 and 4.—Front and End Elevations of Bench

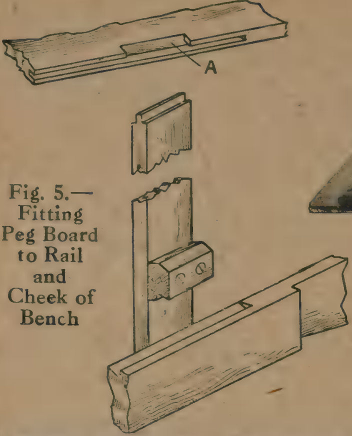


Fig. 5.—Fitting Peg Board to Rail and Cheek of Bench

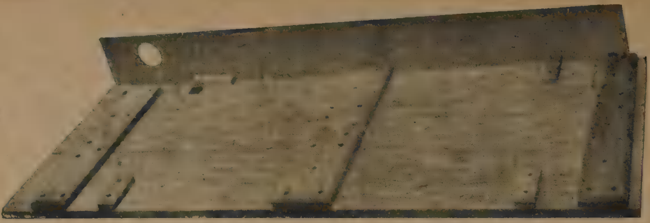


Fig. 6.—Underneath View of Top

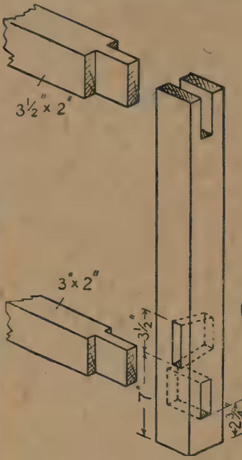


Fig. 7.—Tenoning Rails into Legs

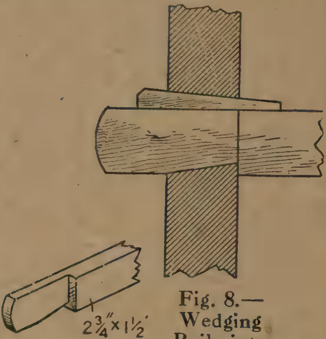


Fig. 8.—Wedging Rails into Legs

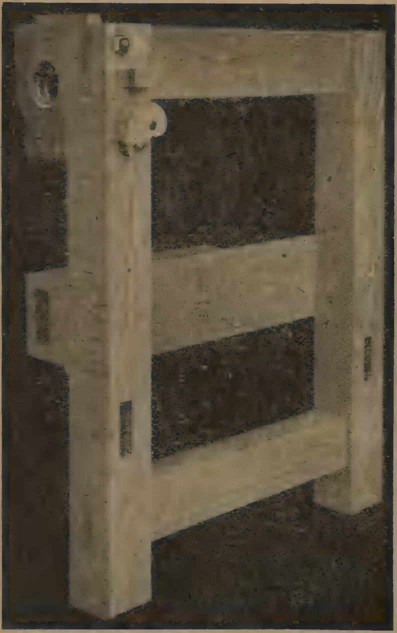


Fig. 14.—Legs with Screw Block and Runner Attached

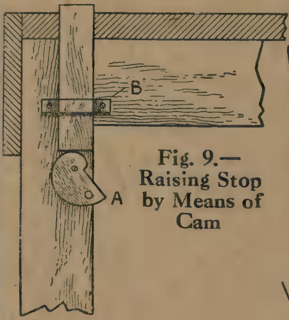


Fig. 9.—Raising Stop by Means of Cam

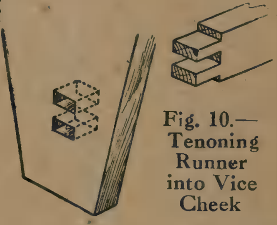


Fig. 10.—Tenoning Runner into Vice Cheek

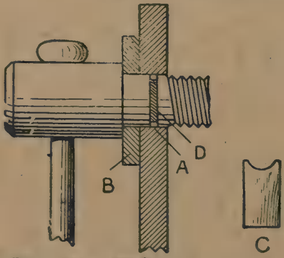


Fig. 11.—Fixing Screw to Cheek of Vice

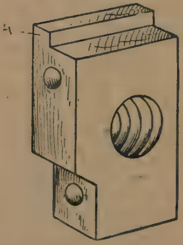


Fig. 12.—Screw Block

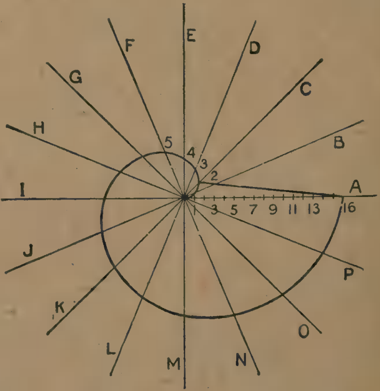


Fig. 13.—Setting Out Pattern of Cam

hole should next be cut in the bench cheek, to correspond with that in the block; and, in order to form the vice cheek, plane up and shape a $1\frac{1}{2}$-in. board to 1 ft. 10 in. long by 8 in. wide, as in Figs. 1 and 3. After cutting a hole for the screw, place the screw in position so that the groove in the shank A (Fig. 11) is in the centre of the cheek, and next cut a block B to fill the space. For holding the screw in the vice cheek and yet to allow of its revolving freely, a piece of hardwood shaped as at C is inserted in a mortise D made in the side of the cheek. The runner is $2\frac{1}{2}$ in. wide by 1 in. thick, and should be tenoned into the lower end of the cheek, as in Fig. 10. The guide box for the runner is clearly shown in Fig. 2, and should be fixed to the legs after the screw has been fixed in position on the bench.

The peg board, shown clearly in Fig. 3, is adjustable, and is of great convenience in jointing and planing long boards, as the peg may be inserted at a suitable length and height, and will bear a large amount of the weight of the work, and thus lessen the leverage on the jaws of the vice. It is 5 in. wide and $\frac{3}{4}$ in. thick, and is made to run in grooves cut in the top edge of the front rail and the under edge of the bench cheek (see Fig. 5). So that the board may be easily placed in position after the bench has been put together, a small piece is taken out at the end of the groove in the cheek, as indicated at A.

The bench stop should be of close-grained hardwood, 8 in. long by $1\frac{1}{2}$ in. wide by $1\frac{1}{4}$ in. thick, and the method of raising it above the bench top is by means of the cam A (Fig. 9). By gently turning it round clockwise, the stop is gradually raised above the surface of the bench. The cam is fixed to the inside of the front leg, by means of a screw, which should be driven in just enough to enable the cam to work easily, a metal washer being inserted between the cam and the legs. The stop should work easily in the mortise made in the bench top, and in order to keep it in a vertical position it is held loosely in a metal staple B, which could be made from a piece of sheet metal or thick wire. The cam needs to be shaped in such a way that the outside curve gradually and uniformly increases its distance from the centre. To set out the shape of the cam proceed as follows: From a centre draw sixteen radiating and equidistant lines, and letter each line from A to P (see Fig. 13). On line A mark off sixteen divisions from the centre, say $\frac{3}{16}$ in. apart, and number each division. Now starting with the line B mark off one division on this, and two divisions on C, three divisions on D, four divisions on E, and so on until the sixteenth division is reached on A. Now through these marks the exact curve can be drawn, the centre being the point through which passes the screw on which the cam turns. A knob screwed in as shown forms a handle for turning the cam.

Preparing Special Papers

No attempt will be made in this article to tell the homeworker how to make paper, but there are many special kinds of paper which may be prepared easily at home if the worker has one or other of the ordinary makes to start with.

Tracing Paper.—A much advocated method of making tracing paper is to coat a suitably thin and semi-matt surfaced paper with thin dammar varnish and allow to dry, but while this answers very well, the paper is apt to become very tacky when the warm hand is laid upon it, and it soon becomes very brittle. Dammar is used largely for the production of cheap commercial papers, but pale poppy-oil varnish is mixed with it, and the paper, after treatment, is sprinkled over with very fine pine sawdust, which is removed at once by aid of a brush. This treatment removes the superfluous varnish or oil, which otherwise would form a crust. The formula for the mixture is: Powdered gum dammar, 420 gr.; turpentine, 5 oz.; poppy-oil varnish, 3¼ oz.

By far the simplest plan, and one specially suitable for home use, is to treat the paper with a varnish made with equal parts of canada balsam and oil of turpentine made warm. If the paper is very thin, less balsam will serve; for tissue paper, for example, 1 oz. of balsam in a ¼ pt. of turpentine will answer. Another plan is to rub paper with a mixture of nut oil and turpentine in equal parts, immediately drying by applying dried wheat flour and hanging up for 24 hours. These papers serve for pencil work, but if required for fine work with ink or water colours, they should be washed over after drying with a weak solution of oxgall, and again dried.

The famous Esslinger formula for tracing papers is: Bleached shellac, 3 parts; mastic, 1 part; pure alcohol, 20 parts. The sheets of paper are coated with the clarified solution, and hung up to dry until the paper has lost all its moisture and tackiness. This paper is largely used by colourists, but the colours must be mixed with alcohol and not water.

Temporarily Transparent Paper.—All good tracing papers remain translucent, but a paper temporarily transparent is sometimes useful. Such a paper may be made by passing over it a sponge dipped in petroleum, and squeezed out again. The paper becomes transparent at once, and can be used for copying without delay, provided the amount of oil was so small that the paper appears to dry within a few minutes. One application will serve for thin paper, but if thick papers are used, both sides may have to be treated. Petroleum being a volatile liquid the treated paper loses its transparency in a few weeks if exposed to the air.

Fireproof Paper.—Paper dried after soaking in a solution of borax, phosphate of soda, sal-ammoniac or chloride of zinc will not flare when placed in contact with fire. About 1 oz. of one of the salts dissolved in from 10 oz. to 20 oz. (½ pt. to 1 pt.) of water will serve, but some papers may require a saturated solution, made by adding the chemical to the water until the latter refuses to dissolve any more. The same solutions will also serve for wood, and cotton and linen fabrics.

Waterproof Paper.—Paper may be made water- and grease-proof by dipping in a saturated solution of borax in which shellac has been dissolved by gentle heat. The borax is added to warm water until the liquid will dissolve no more and from 1 to 3 oz. of shellac added to each pint of solution. A commercial method of making such paper is as follows: Six oz. of alum and 1 oz. of white soap are dissolved in as little warm water as possible; another solution is then made by dissolving 2 oz. of gum arabic and 2 oz. of glue in about ½ pt. of warm water. These two solutions are then mixed while warm, or the whole warmed up afterwards, and the paper dipped in the mixture and hung over a string in a warm room to dry. This paper is very useful for packages exposed to the damp.

Ink Eradicator Paper.—This is a useful paper for office use, as it is a blotting-paper which causes blots to disappear more or less according to the nature of the ink. It acts best with inks containing iron, but will not eliminate aniline inks. One part of oxalic acid is dissolved in 4 parts of hot water, and ordinary blotting-paper soaked therein and dried. The freshly made blot is blotted with this paper; but if the blot has dried, the ink must be thoroughly wetted before the paper will do its work.

Repairing Plastering

Broken, badly cracked, or fallen plaster-work in ceilings or on walls is both unsightly and a source of inconvenience and dirt. Caused in a variety of ways—in the moving of tall heavy furniture, by water leakage, etc.—the damaged surface spoils the appearance of any room, but is by no means difficult to repair.

Fig. 1 is a photograph of a hole in a ceiling to be repaired. Both laths and plaster are broken, this being the result of an accident in which a householder, while placing some boxes in the roof space of a house, stepped on the plaster-work, his heel passing through the ceiling. The first thing to do is to clear up the fallen plaster, etc., and then to spread a large sheet on the floor under the hole. Put on an old coat and tie the sleeves around the wrist; get a pair of steps to reach the ceiling and remove with the hands and a trowel all loose, cracked, or unsound portions of the plastering, together with all the broken or splintered laths. The laths are cut to wherever they are found to be sound by means of an old chisel and mallet, taking care to sever them at the centres of the under-sides of the floor joists, so that new laths may be firmly attached. Upon the thoroughness with which the defective work is removed depends very largely the success of the job. The defective portions show very clearly in Fig. 1. The hole should be brushed on the edges to remove dust, etc., and the debris should be taken completely away.

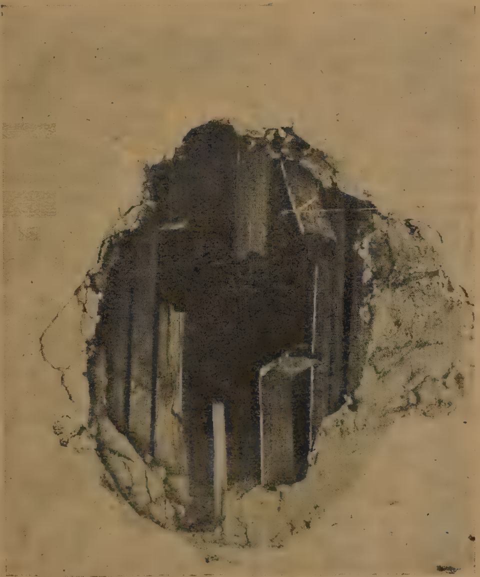


Fig. 1.—Hole in a Plastered Ceiling

Tools, etc.—The tools, etc., required will be as follow: A trowel, pail, brush, mortar-board, straightedge or rule, float, and hawk. The first three are to be found about the house; the mortar-board consists of any convenient piece of battened wood, say 18 in. square; the rule is 2 ft. 6 in. long and 4 in. wide, planed true on the edges; the float (see Fig. 2) is a piece of selected wood, 12 in. long and 4½ in. wide, planed true and smooth on

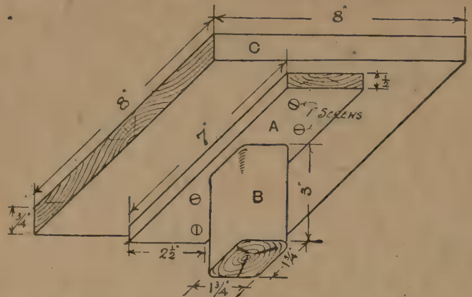


Fig. 3.—Hawk, or Hand Mortar-Board

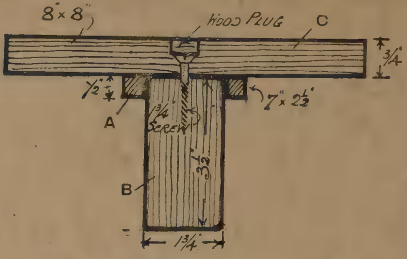


Fig. 4.—Section Through Hawk

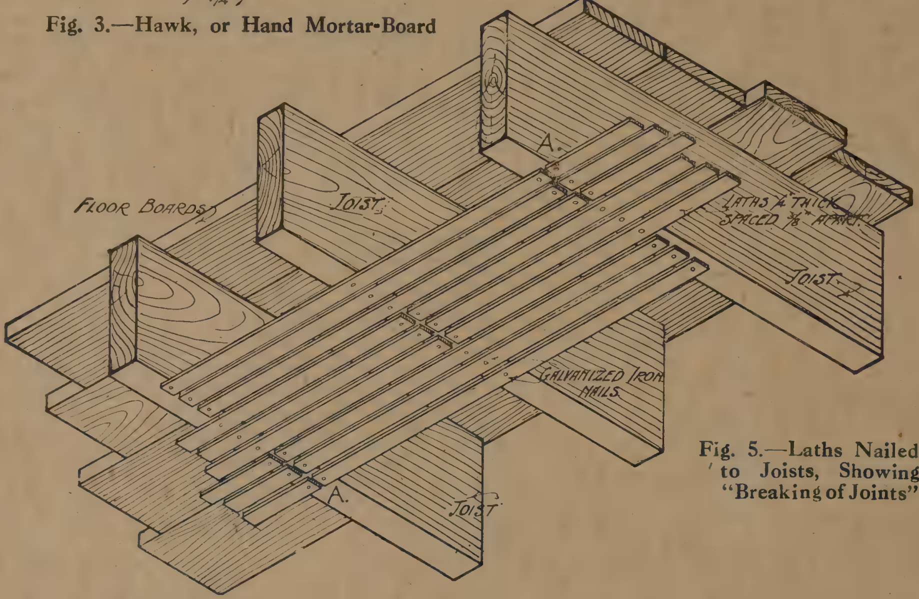


Fig. 5.—Laths Nailed to Joists, Showing "Breaking of Joints"

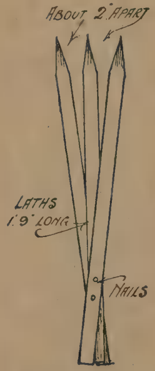


Fig. 6.—Pointed Laths for Scratching Undercoat

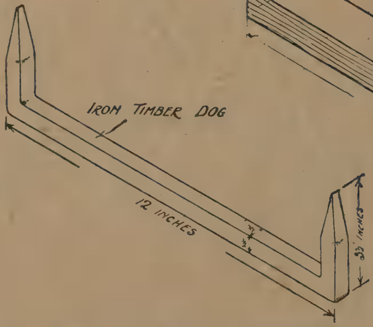


Fig. 7.—"Dog" for Scraping Joints in Brick Wall

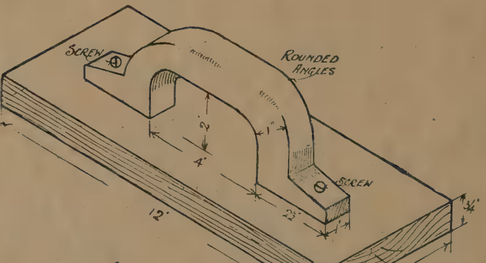


Fig. 2.—Dimensioned Sketch of Float

the under-surface and provided with a shaped handle screwed on; the handle is easily made from a straight-grained piece of hardwood, 1 in. thick, to the dimensions given in Fig. 2, or it may consist of the handle removed from a discarded blacklead polishing brush. A little extra time given to the making of this and other tools is very well spent, as they will be found continually useful for odd jobs about the house. The hawk is really a hand mortar-board. This, again, need not be purchased, but can be made according to Fig. 3; it consists of a top board C about 8 in. square and $\frac{3}{4}$ in. thick, to the under-side of which is strongly screwed a piece of stuff A 7 in. long, $2\frac{1}{2}$ in. wide, and $\frac{1}{2}$ in. thick, to prevent the top warping and twisting. The handle B is a $3\frac{1}{2}$-in. length of $1\frac{3}{4}$-in. by $1\frac{3}{4}$-in. stuff, rounded on the edges, the batten A being cut to receive it. The method of fixing the handle to the top is shown in Fig. 4. The hole for the $1\frac{3}{4}$-in. screw is cut deeply into the top and then the screw is countersunk, the hole being filled with a wooden plug which prevents the mortar being stained by the rust which ultimately forms on the screw-head. An alternative form of handle could easily be made from a $3\frac{1}{2}$-in. length of broom handle. A well-worn good-quality distemper brush will be found useful.

The Lathing.—First it is necessary to make good the broken lathing. Split or riven laths of the size termed "lath and a half" are the best for repair work; they are about $\frac{1}{4}$ in. thick, and are obtainable from builders' merchants and timber yards in varying lengths, 2 ft. 6 in. being economical in use. Laths are secured to the under-side of the joists by stout galvanised-iron nails and are butt-jointed to each other. Fig. 5 is a diagram showing them in position. They are placed $\frac{3}{8}$ in. apart, this forming the proper key for the plaster. This diagram shows, also, how the joints in the length of the laths are "broken" as often as is convenient (see A), thus avoiding a continuous line of joints along the under-side of one joist. Do not forget to nail the loose ends of existing laths (see Fig. 8). The amateur will find it wise to protect the surrounding work from serious soiling by water splashing, etc., by covering up the remaining portion of the ceiling with newspapers attached by means of small drawing-pins.

Plastering is either three-layer work or two-layer work, known respectively as "plaster, float, and set," and "plaster and set." Fig. 1 shows that the work is executed in the former way, but repair jobs are usually carried out by the latter method, the floating and setting coat being combined in one operation.

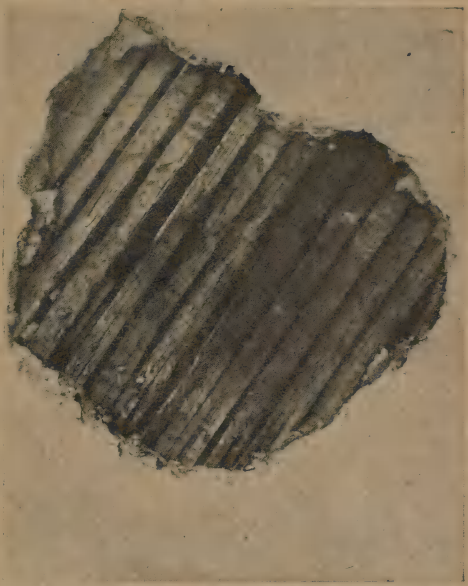


Fig. 8.—Laths Nailed to Rafters Ready to Receive First Coat

Fig. 9 shows the plaster or first coat finished to the hole. First the hole is wetted around the edges and on the laths. This is done with a brush dipped in a pail of water, and then by quick, sharp movements of the wrist the water is thrown from it. This coat is composed of Sirapite plaster and sand in the proportion of 1 of plaster to 3 of sand. The former can be bought cheaply from many builders' merchants. A little clean cow-hair beaten out and mixed with this coat will bind it together effectively, and is advised. The stuff is thoroughly mixed up on the mortar-board, transferred with the trowel to the hawk, and then applied to the laths with the float. The left hand follows the right with the hawk to catch the portions of plaster which fall. Test the coat to see that there is not too much in the centre to prevent the finishing coat being put on with the straightedge both across and diagonally of the hole. The first layer should finish within $\frac{3}{16}$ in. of the finished surface. As will be seen in Fig. 9 the first coat is scratched over to form a key for the second one. For doing the scratching, three laths are roughly pointed and nailed across one another as shown in Fig. 6. The first coat should be allowed a day or two to set before applying the finishing layer.

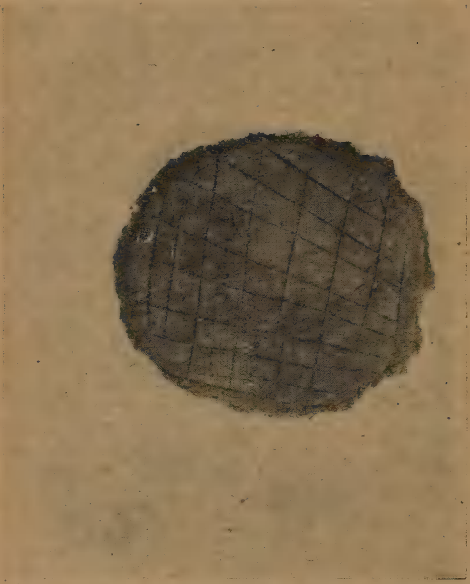


Fig. 9.—The First Coat Scratched to Receive Finishing Coat

The finishing coat is composed of plaster of Paris, obtainable at oil-shops in packets for a few pence. It is mixed on a perfectly clean mortar-board, transferred with the trowel to the hawk, and then applied to the hole with the float. It should be made up in small quantities, as it sets very quickly. When the surface has been floated fairly true it should be tested again and again with the straightedge, this being drawn across it to bring all places level and correct. In the case of old ceilings the irregularity of the remaining portions prevents the use of a long straightedge or rule, and a shorter one should then be employed. The float is caused to make curved strokes. The plaster should now be allowed to dry thoroughly. Of course the whole of the ceiling should be whitened afterwards, but quite a satisfactory job can be obtained by sticking a piece of white lining paper over the repair, well thinning down the edges of the paper so as to cast the least possible amount of shadow; or the repair may be touched up with a little whitewash.

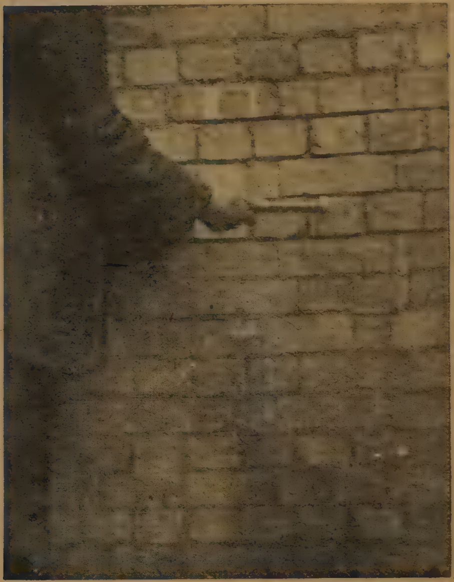


Fig. 10.—Scraping Joints in a Brick Wall with "Dog"

In the case of brick walls, the same processes are gone through as to the removal of defective work, and the joints scraped out with any handy tool, the proper one being the iron dog shown in Figs. 7 and 10, the latter illustrating the tool in use.

Overhauling a Motor-cycle

Whilst a motor-cycle is in actual use there are many adjustments of a minor kind that could and should be made, but eventually there comes a time when a complete overhaul is necessary, both from the point of view of getting the utmost efficiency out of the machine and that of preventing its rapid deterioration. The question of when an overhaul is necessary does not require any great discrimination, unless the machine is a strange one to the rider, such as would be the case with one purchased second-hand, for the whole question generally may be summed up as looseness and want of cleanliness. Looseness may be due to wear or want of adjustment, and want of cleanliness means the presence of carbonized oil in the various parts of the engine and an accumulation of dirt and grit in the road-wheel bearings, etc.

If an overhaul is decided upon it should be made thoroughly for then satisfaction will result, and the time spent upon it will be amply repaid. Such matters as replating and re-enamelling can, of course, be left to the inclination of the reader as they do not affect the running of the machine, although they preserve the metal, particularly in the case of thin metal parts, such as mudguards and rims, which, if not protected, are liable to rust through. The overhaul of a motor-cycle does not necessarily mean that any new parts that may be required should be made by the owner; but rather that everything on the machine, including the frame, tyres, engine, ignition apparatus, and the tank, should be carefully examined and cleaned, or renewed where necessary. In the case of the frame it can be carefully tested for truth and soundness; the tyres can have the cuts stopped up; the engine can be adjusted in parts, the magneto cleaned and adjusted, and the tank, if necessary, repaired.

The first procedure is to empty all petrol and oil out of the tanks and then to give the machine a thorough external cleaning with paraffin. This latter treatment will greatly facilitate the dismantling of the machine which can now be proceeded with. After the controls have been loosened, the transmission, engine and gear-box should be the first items to remove, as with the lessened weight the cycle will be found much easier to handle. As far as is possible, remove each unit entire, and deal with it as a unit when the actual overhaul is taken in hand. With some machines the engine and magneto can be removed together, though in other cases it will be necessary to remove the magneto first. As machines of different makes vary in construction it will be understood that specific instructions cannot be given, and therefore a certain amount of judgment will be necessary. Front and rear wheels should be taken out next, and, with them, of course the brakes, followed by the mudguards. Having arrived at this stage, it will be advisable to decide in what order the overhaul is to be conducted, a matter which should depend on what there is to be done. For instance, should the engine require rebushing, or require new parts which may take some time to get, it will be advisable to tackle the engine first, or, on the other hand, if it is decided to re-enamel the machine, the frame and all enamelled parts should receive first consideration. For the purpose of these instructions this latter will be assumed to be the case and the overhaul dealt with in that sequence.

Frame, etc.—Proceeding then with the frame, everything that is removable should be taken off, even to the smallest screw or clip. The steering head should be loosened and the handle bars removed, and the front forks withdrawn. The steering head balls and races should be removed and washed in paraffin, and afterwards carefully examined for flaws, breakages and wear.

Next proceed with the dismantling of the front forks. Well clean the spindles and test them in their respective sleeves for looseness. The thorough cleansing of parts is an important matter, because but little idea of fit can be obtained with dirty or oily components. Discretion must be used as to whether a worn part will pass muster ; much depends upon the function of the particular part. For example, a small amount of play in the spindles of a spring fork is permissible, but a fraction of the same amount would not be allowable in certain parts of the engine.

Parts that require replacement should be placed on one side. Whenever possible, nuts should be temporarily replaced on their respective bolts, as this will save a good deal of trouble and confusion when assembling.

The remaining enamelled parts, such as mudguards, stand, carrier, etc., should all be inspected and any necessary repairs carried out ; mudguards may require reshaping a little, or a patch riveting on, and the stand and carrier may perhaps require rebrazing. The oil pump and any attachments should be taken off the tank and the latter carefully inspected for leakage or possible sources of future leakage in the way of partly-worn or strained places caused perhaps by any rubbing action that has taken place. Such places can be covered with patches of thin sheet brass carefully soldered on. All seams should be minutely examined and strengthened if necessary.

When soldering a petrol tank it is of the most vital importance that no naked flames should be brought near it, or that the soldering iron should not be hotter than is necessary for the work. Even though the tank be dry there may be sufficient petrol vapour in it to cause a disastrous explosion should it become ignited. Before starting soldering the filler cap should be removed and the hole turned away from the worker.

If the re-enamelling is to be done at home all the enamelled parts should be scraped clean and polished with emery cloth, taking care that no rust remains, as this would eventually come through the enamel. After they appear quite smooth and clean they should be given a good rubbing with a cloth dipped in petrol to remove all grease, a second rubbing with a cloth soaked in turpentine, and then be finally dried with a perfectly clean cloth.

The frame and forks should now be tested for soundness and truth. One method of testing is to suspend the frame somewhere, and tap the tubes with a piece of metal ; if a clear ringing sound is heard, all will be well, but if a dull sound is heard, it indicates that a flaw is present. Should the frame or forks be twisted it will be advisable—unless the reader has the facilities and experience—to put it into the hands of a reliable cycle repairer for treatment.

Re-enamelling.—Assuming that everything is satisfactory and the frame is perfectly clean, it can be enamelled with brush enamel. Or a better procedure for home enamelling is to apply three coats of flat paint, allowing each to dry hard, and rubbing it lightly down with pumice powder and water before the next one is applied. The last coat having been made thoroughly smooth, a couple of coats of the best carriage varnish should be applied, and the result will be almost the equal of stove-enamelled work.

Wheels.—The wheels should be the next consideration. The tyres should be removed, and the covers cleaned and carefully examined for cuts, both inside and outside. Those on the inside should be covered with stout canvas attached by means of strong solution, and the outside cuts can be filled with one of the many tyre stoppings sold by the dealers; but if they are very large, vulcanizing is necessary. The inner tubes should be pumped up fairly hard, and tested under water, particular attention being paid to the joints of the valves with the tubes; if necessary, cement on a new patch, and also repair any other punctures. New valve tubes in the case of rubber valves should be fitted, as these always perish after a time.

Removing Dents from Rims.—The rims should be closely examined for dents, etc., and if any are present they must be removed. The best method of doing this is to place a piece of metal under the bead, and carefully hammer the rim with a lead or brass hammer. If neither of these is available, a piece of hardwood can be held on the rim and struck with an ordinary hammer. It may be said that all the dents can be removed with an ordinary hammer used discreetly; very light hits and plenty of them are required, not a succession of heavy blows.

Truing Wheels.—If the wheels do not run true after the rims have been straightened, they must be trued up. An easy method of doing this is to hold the axle in a vice (between the jaws of which have been placed two pieces of lead or copper so as not to mark the work), and slowly turn the wheel round. It will then be easy to note the amount that the rim is out of truth, and a piece of chalk can be held against the rim in such a manner that it only touches the part that is out of truth; the exact spot is then seen. The nipples on the opposite side of the rim should each be given a third of a turn or so until the rim runs nearly true. This operation may not always set the rim true, and it will perhaps be necessary slightly to unscrew the nipples on the opposite side of the rim. Care must be taken that the spokes are all tightened alike and that the tension is equal; this can be tested by striking each spoke to see if they give the same note.

Particular care must be given to the spoke nipples. Any spokes projecting through them must be filed off, as many punctures can be directly attributed to the spokes projecting over the tops of the nipples. To the inexperienced the truing of wheels is not an easy matter, and it may be advisable to place them in the hands of an experienced man who will not take many minutes over the job.

Ball Bearings, etc.—The axles should be taken out of the wheels, and the balls, cups, cones, nuts, and spindles cleaned and examined. If the cones or cups are badly worn they should be replaced, and each ball should be inspected carefully and, if possible, measured with a micrometer; if any flats are present, or if the balls vary in size, new ones should be fitted. If the threads are worn in the nuts, or on the spindles, new parts should be fitted.

When replacing the axles, etc., the inside of the hub should be filled with vaseline or grease as used in a motor-car gear-box; this will last a considerable time. The wheels can be finally adjusted when assembled later in the frame.

Re-assembling Frame, etc.—Assuming that the necessary work on the frame, etc., has been carried out it will now be as well to re-assemble it in order that there may not be a multiplicity of parts about with possibilities of loss and confusion. The tyres should first be replaced, and in doing so care must be taken that the tube is not pinched, and a copious supply of french chalk must be rubbed over the inner tube and over the inside surface of the cover.

Next the forks should be assembled and fitted into the frame, remembering to grease well all parts that have to move. Vaseline answers very well for this purpose, but the motor-car gear-box grease is more efficient and more lasting. When assembling ball races it facilitates matters greatly if the race is first thickly covered with stiff grease and the balls bedded into it. The grease serves to hold the balls in position and, if necessary, the race can be held upside down without any risk of their being displaced. In the assembling of any part all screws and nuts should be coated with grease and, before a bolt is finally put in, it is as well first to try it in order to ensure that it will go quite home. Nuts likewise should be tried on their bolts.

Should a screw-hole be coated inside with rust or enamel which prevents the screw going home, it may usually be cleared by filing a small groove up one side of the screw should a screw tap not be available.

When fitting the wheels, ensure that they are placed centrally and that they are in perfect alignment. Great care should be taken that every nut and screw is screwed up tight, but not using so much force as would risk breaking the bolt or screw. Spring washers or split pins should be fitted wherever possible, and it is a wise plan to double-nut such bolts, etc., that will allow of two nuts being placed on them, as this method gives greater security and at the same time is a convenient way of carrying spare nuts.

Brakes.—Particular attention should be given to these. Worn blocks should be renewed, and all cables, rods, nuts, screws, etc., examined. The cable casing should have oil injected into it so that the wire is well lubricated. Should the cable be found to be frayed it should be renewed. Any springs should be closely examined, and otherwise if found in good condition they should be enamelled.

How the Engine Works.—It is fairly safe to assume that the average motor-cyclist is acquainted with the action of the engine of his machine, be it a two-stroke or a four-stroke, but that the job of retiming the engine on the road would give the majority of riders considerable concern ; therefore a detailed statement of the working and timing will not be out of place, as after an overhaul retiming will be necessary. The four-stroke motor-cycle engine in its action is exactly like the motor-car engine, and similar to the ordinary gas-engine and oil-engine. All these are " explosion " or " internal combustion " engines—that is, the motive power is derived from the force exerted by the explosion or combustion of a gas while under compression ; the compressed gas is ignited by means of an electric spark.

In the case of petrol motors, the gas is usually obtained by spraying petrol through a very small hole. A great quantity of air has to be mixed with the vapour before it will explode upon ignition, and the quantity of air that is required varies considerably, atmospheric conditions and the varying speed of the engine causing differences in the demand.

With the four-stroke engine there are four strokes of the piston for every impulse, one being a " power " stroke and the other three " duty " strokes, as it were ; each performs a certain operation that is necessary for the correct working of the engine.

The principle of the " four-stroke-cycle " is shown in the diagrams on the opposite page.

In diagram A the piston is moving downwards on the induction stroke, the inlet valve having been opened by means of the cam at the beginning of this stroke. The piston in descending causes a partial vacuum in the cylinder, which allows the atmospheric pressure on the surface of the petrol in the carburettor to force some of the liquid through the spray hole and then through the inlet valve into the combustion space of the engine cylinder—this is the so-called " suction " of the piston.

It is the pressure of the atmosphere that causes the mixture of petrol vapour and air to rush into the cylinder. The mixture is known as gas. Just before the piston is at the extreme end of the downward (or outward) stroke, the inlet valve closes, and the piston begins the upward or " compression " stroke with both the inlet valve and the exhaust valve

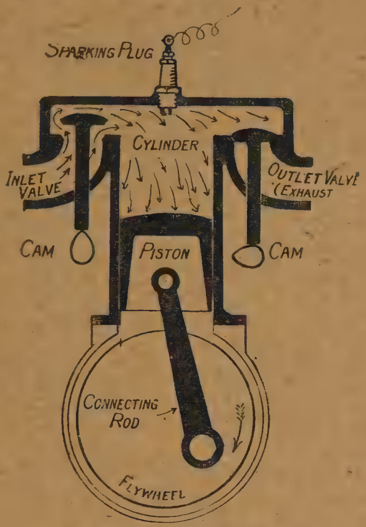


Fig. A.—Suction Stroke in progress: Inlet Valve Open

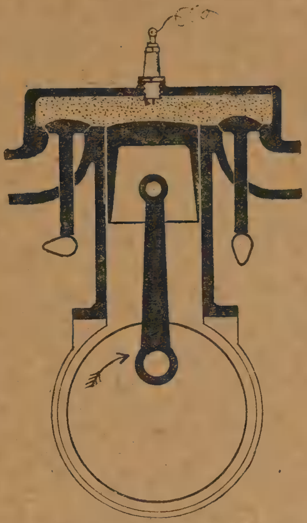


Fig. B.—Compression Stroke completed: Both Valves Closed

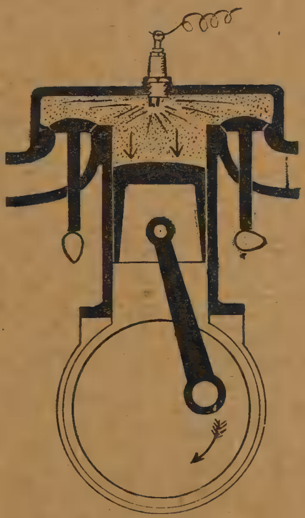


Fig. C.—Power Stroke in progress: Both Valves Closed

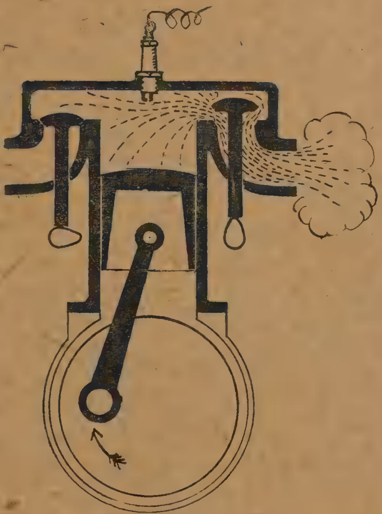


Fig. D.—Exhaust Stroke in progress: Exhaust Valve Open

The Four-stroke-cycle of a Petrol Engine closed. The charge is being compressed when the piston is on its upward stroke, as shown in diagram B. Speaking generally, when the piston is at what is known as the "top dead centre," an electric spark is caused to jump between the points of the sparking plug; this ignites the mixture of gas and air (which is commonly at a pressure of about 80 lb. per sq. in.), and the explosion causes the piston to descend on the power stroke (see diagram C). Just before the piston reaches the bottom of the power stroke, the exhaust valve opens, and remains open during the upward stroke (see diagram D). The momentum of the flywheels, etc., carries upwards the piston, which forces out the burnt gases through the exhaust opening, and from there to the silencer. Immediately the piston begins its next downward stroke, the inlet valve opens, fresh air and petrol vapour are drawn in, and the cycle of operations is repeated as before.

The Two-stroke Engine.—With the two-stroke engine the complete cycle of operations includes two strokes of the piston only—that is the down-stroke and the up-stroke. Briefly, the gas is first drawn into the crank case owing to the partial vacuum produced in the crank case by the up-stroke of the piston. On the completion of the next down-stroke of the piston this gas is transferred via the transfer port, which is opened in the cylinder wall by the piston itself, and at such time as the exploded charge has dropped to atmospheric pressure owing to the exhaust port having been opened by the piston.

The new charge, entering through the inlet port, is deflected to the top of the cylinder by means of the shaped top of the piston, when the latter is at the bottom of the stroke. The piston then ascends and compresses this charge, which is then fired. At the same time a fresh charge is induced into the crank case. It will thus be seen that an explosion occurs with every down-stroke of the piston.

Overhauling the Engine. — Before taking the engine to pieces the outside of the crank case and the exterior of the cylinder should be scraped clean. Paraffin can be used for removing the grease on the crank case and the burnt oil on the outside of the cylinder. The nuts that hold the cylinder on the top of the crank case can then be taken off and the cylinder removed. The timing case cover can now be taken off and the rocker arms and cam wheels removed. Probably the latter are marked, and note should be taken of the markings in order that the timing can be reset in the same position when the engine is re-assembled.

Should the wheels not be marked, the timing can be reset according to the instructions given later which may result in an improvement on the existing timing, for the original and correct setting may have been departed from at some previous time. The engine should now receive a thorough washing with a plentiful supply of paraffin until all traces of old oil are removed; all carbon deposit should be scraped out of the cylinder head and off the piston.

When quite clean, a very thorough inspection should be made of the entire engine, which, to be in good order, should present the following conditions:—(1) There should be no up-and-down play of the piston rings in their grooves, but they should be sufficiently free to turn round; the gaps of the rings should not exceed $\frac{1}{50}$ in. when entered into the cylinder. (2) The piston should be an easy fit into the cylinder with the slightest suspicion of side movement, but in this connection it should be remembered that less wear will have taken place at the mouth than at the top of the cylinder; no trace of an up-and-down movement of the connecting rod should be felt as would be the case if the crank-pin, gudgeon-pin or bushes were worn. (3) No looseness of the crankshaft should be felt in the main bearings but a little side play both of the crankshaft and of the connecting rod small end are always allowed. (4) The wear on the cams of the timing wheels, if any, should be so slight as not to interfere perceptibly with the full lift of the valves. (5) The spindles of the cam wheels should be a nice fit in the bushes. (6) With regard to the cylinder there should be no signs of scoring and very little, if any, wear shown when tested with calipers. (7) The valves should have no more than a trace of side play in their guides, and the heads should not be pocketed in their seats.

An engine in the above condition would be fairly good, and the question arises as to what amount of wear or looseness is permissible. Only the desired thoroughness of the overhaul can determine this, together with due consideration of the work a particular part has to do. For instance, take the case of wear at the connecting-rod big-end. The slightest looseness here would cause knocking and further result in rapid deterioration due to the hammering action set up. Now consider the matter of a valve loose in its guide ; the bad effect of this would not be nearly so great, and the chief detriment would perhaps be increased difficulty in starting the engine and its inability to run slowly. Therefore, it is evident that much must be left to the discretion of the repairer. A pocketed valve would mean loss of power as would poor compression and badly-worn cams. Fitting a new bush will not necessarily remedy a loose bearing, although it may partly do so, for it must be remembered that wear will also have taken place on the pin or spindle.

The rebushing of an engine does not present any real difficulty, but it will, of course, necessitate taking the engine entirely to pieces. New bushes (and pins, if necessary) should be obtained from the makers, and after the old bushes have been driven out should be pressed into place. Assurance must be made that they are a tight fit in their housings, and that any oil holes register with the corresponding channels or holes. Unless rebushing is necessary it is better not to remove the piston or take apart the crank case, unless in the case of the latter there has been a leakage of oil at the joints.

Attention should be given to the valves and also the state of the seats. If the valves are much pitted it is useless to try and grind them on the seats ; such a proceeding is disastrous, as it causes great wear on the seat. The only thing that can be done is to have the valve ground on the face while it is revolving between the centres of a grinding machine or lathe, care being taken that the new bevel is the same as the old one. After the faces have been ground the valves should be placed on their respective seats and ground in with fine emery or carborundum and oil until they fit.

The valve springs should be tested, and any that appear to have lost their elasticity should be renewed. Should the seats be pocketed it will be necessary to have them machined out if full efficiency is to be secured.

Re-assembling the Engine.—After the engine has received the necessary treatment it can be re-assembled. Thick gold size is the best medium to use in the joints of the crank case, and a paper washer soaked in gold size between the cylinder and crank case. It is advisable to renew all copper-asbestos washers.

The timing of an engine, as already stated, is facilitated by the marks usually placed on the cam wheels by the makers. As a certain amount of variation exists with different makes of engines, precise instructions cannot be given, but the following will be suitable for the majority of four-stroke engines. The exhaust valve should be set to close when the piston is on the top dead centre and the inlet valve should begin to open when the piston has travelled $\frac{3}{16}$ in. on the following downstroke. With some engines it may be found to be an improvement to allow the exhaust valve to close just after the dead centre—say 10°, and 15° for the inlet valve opening. The magneto should be coupled up so that when retarded the points just start to open when the piston reaches the top of the next stroke. A gap of $\frac{1}{64}$ in. should be allowed between the valves and the valve tappets.

Oil Pump.—The oil pump should be taken apart, examined, and, if necessary, a new cup leather fitted on the plunger. In the case of an automatic lubricating system, the parts can be inspected, and where necessary new ones fitted. Observe that the valves have perfect freedom of movement. In all probability the stuffing glands will require repacking. Ensure that the filter is quite clear.

Carburettor.—This should be taken completely apart, and the float, balance weights, needle and seat, and filter examined. In the bottom of the carburettor may be found small pieces of grit, and the filter itself may be quite full of grit. All particles of foreign matter must be removed before the carburettor is reassembled. If the balance-weight pivots are worn, new ones should be provided.

The float should be examined, as it is possible that it has become punctured. If such is the case, it should be immersed in boiling water, when the presence of bubbles, caused by the generation of petrol vapour, will reveal the position of the puncture. Before the hole is soldered up all the petrol must be evaporated out by leaving the float in a fairly warm place for some time, but in this case again precautions must be taken to guard against fire. It is of great importance that the weight of the float should not be materially increased by superfluous solder.

After the carburettor has been made mechanically sound, the petrol level should be tested. To carry out this test the carburettor (with the mixing chamber removed and the petrol pipe fitted) should be supported horizontally. Petrol should now be poured down the pipe until the float chamber is full, the top of the jet being carefully observed meanwhile. When the chamber is full, the level of the petrol should be just below the top of the jet. Should it overflow, the level is too high. The method of lowering the petrol level will depend on the type of carburettor; in the case of a carburettor with toggle levers and the valve at the bottom, the collar on the needle will require lifting up the needle stem. Should the action not depend on toggle levers and the valve be at the top of the carburettor, the collar will require lowering. Usually, the collar is simply a driving fit on the needle stem. The converse of the above adjustments would, of course, be necessary if the level is too low. Should the carburettor flood in spite of adjustment the needle valve must be ground in with fine crocus powder and oil.

Magneto.—The magneto should be carefully cleaned and oiled. Examine the opening of the contact-breaker points and set these to open to a maximum distance of ·04 in., and at the same time ensure that the rocker arm works freely and that the points come together squarely. The carbon brush should be examined and if worn renewed. Should the spark be weak after the above adjustments have been made, reference should be made to the fully illustrated chapter on magneto repair appearing later in these volumes.

Gears and Drive.—If the machine has a gear box all the grease should be washed out of it with paraffin and the gears carefully examined. The bearings of the shaft should be tested and assurance made that they turn quite freely. Little can be done in the way of gear-box repair by the amateur beyond the replacement of worn or damaged parts. Actuating devices, such as forks, wedge-bars, etc., should all be inspected and their action considered when the gears are assembled in order to make sure that they fulfil their purpose correctly and that no motion is lost. Driving chains should be well washed in paraffin and then placed in a bath of molten tallow for about ten minutes. If the sprockets are worn to any extent they should be renewed. A worn pulley of a belt-driven machine should be replaced unless the wear is very slight, in which case it can be skimmed up in a lathe, but care must be taken that the angle of 28° of the sides is maintained.

Completing the Overhaul.—Assuming that everything has been overhauled, parts replaced where necessary, and that all is satisfactory, the assembling of the machine can be completed.

It will be found advantageous in some cases to place rubber blocks between the under-side of the tank and the frame; these act as an additional support for the tank and prevent noise and wear. Many tanks only hang upon the frame, and in cases of this kind the tank top is constantly bending outwards and inwards as the machine is shaken on the road—a system that is responsible for many leaking tanks. All controls should be re-examined when they are fitted in order to make sure that they are the correct length and actuate correctly the part to which they are attached. The wheels and steering should be tested for freedom of movement.

Finally, after all appears to be in order, all nuts and screws should be again gone over and tried for tightness.

Speaking Tubes

A SPEAKING tube is often of great convenience, being more easily installed, and offering certain advantages over the telephone for short-distance work. Since its efficiency depends upon the sound waves travelling through the tube without disturbance or loss, the tube must be as straight and as smooth as possible. By confining sound to a tube it will travel farther without loss of intensity than occurs in an open, unconfined area.

A tube made expressly for this purpose and known as "speaking-tube" is obtainable from plumbers' warehousemen, and for it there are proper bends made. This tube is made of zinc, with smooth-soldered joints, and where tube joins tube an outside sleeve or ferrule is used, soldered on. The bends sold with this tube are rather more abrupt than they should be for long-distance work, but they are not so abrupt as to be termed elbows. The sizes of tubes are $\frac{1}{2}$ in., $\frac{5}{8}$ in., and $\frac{3}{4}$ in., which would be used for lengths of, say, 100 ft., 250 ft., and 500 ft. respectively. 500 ft. is the limit under the best conditions of straight runs, with few bends and little external noise.

For comparatively small requirements, "compo" tube (as formerly much used for gas) is excellent, and is easily run. Being of smooth bore, it is possible in most cases to give wide sweeps when changing the direction of the run. Care must be used not to "kink" it, and where a joint has to be made let the pipe ends come true together, and be secured by a sleeve outside them, soldered on.

For outdoor work, iron gas-tube is often used, but there is no disguising that it is rather rough inside, and each joint interferes with the sound-travel. If it could be arranged for the pipe ends to butt together inside the sockets there would be a distinct improvement, especially if bends, not elbows, be used where the pipe changes direction.

Iron pipe is of advantage when the tube has to be carried underground, but if zinc or compo could be surrounded by a wood casing packed with silicate cotton, sand or ashes, it would serve for outdoor work better than iron pipe—that is, it would convey the sound more perfectly, while the packing would be quite effectual in shutting out all external sounds in noisy places.

At each end of the tube there must be fixed a mouth-piece and whistle. It is known, of course, that to call anyone at the distant end of the tube the lips are put to the mouth-piece, and the tube is blown through, this rush of air causing a whistle to sound, and as there is a mouth-piece and whistle at each end the call can be made either way. These mouth-pieces are not of a sanitary nature if used by several people, and there have been introduced fittings that have a mouth-piece to speak into, while the air blast is made by pressing a bulb.

There is now an improved fitting which has the air-bulb, a mouth-piece to speak into, and a fitting that comes against the ear at the same time. Previous to this, the mouth-piece was held to the ear for hearing, but with the new fitting the speaking and hearing parts are separate (as they are with the telephone), and to perfect the whole the whistle is designed so that it is not loose and cannot be left out or fall out.

Hay-box or Fireless Cookers

THERE has been a return of the old interest in the hay-box cooker. This is a simple arrangement consisting of a box half filled with hay and possessing a well fitting cover, into which anything that has been brought to boiling-point on the range or gas jet may be placed, then tucked round with the insulating material, and left by the action of its acquired heat to finish the cooking; or, if cooked, to keep warm until required for the table. For the latter purpose it answers well enough, but for the former it is not so satisfactory, for reasons made clear later in this chapter.

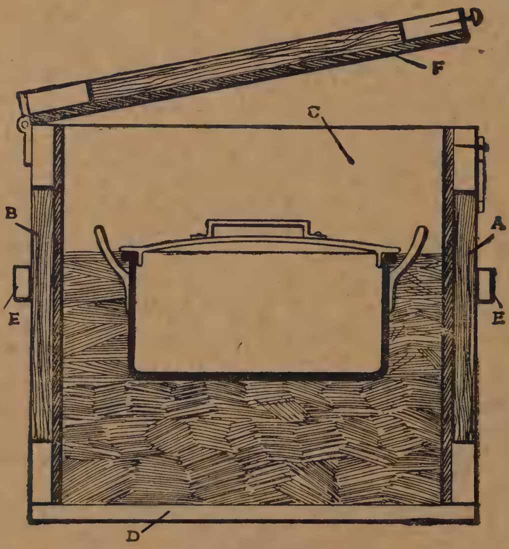


Fig. 1.—Section through Ordinary Type of Hay-box Cooker

Construction of a Typical Hay-box or Fireless Cooker.—There is no difficulty in making a hay-box cooker, scarcely any particular instruction being necessary. The arrangement is illustrated by Fig. 1, which is a section showing all that need be shown. The cooker consists of a wood box built up with four sides and a bottom, and a hinged cover. The front and back A and B are best framed up, but this is not essential. The framework consists of four rails 1 ft. long by 2 in. wide by $\frac{3}{4}$ in. thick, framed together with half-lap joints glued and nailed or screwed. These frames are lined on the inside with $\frac{1}{4}$-in. boards, preferably ply wood, nailed on. The two sides of $\frac{1}{2}$-in. thick ply wood should be 1 ft. 2 in. long by 1 ft. deep, and are nailed or screwed to the side rails of the front and back frameworks. The bottom D, also of ply wood, is 1 ft. 2 in. long by 1 ft. 1 in. wide by $\frac{1}{2}$ in. thick, nailed or screwed on. Obviously, any strong existing box can be used instead of building a special container.

Two handles E, at the front and back respectively, should be 1 ft. 1 in. long by 1 in. deep by $\frac{1}{2}$ in. thick; they are simply nailed or screwed on. The cover F is framed together in the same way as the back and front, and covered on the inside with a ¼-in. panel; side rails of the framework of the top are 1 ft. 2 in. long by 2 in. wide by ¾ in. thick, and the top and bottom rails are 1 ft. 1 in. long by 2 in. wide by ¾ in. thick. The cover is attached by means of a pair of 2-in. butt hinges, and is secured in front by a hook catch and either a screw or a brass-headed nail.

Over the cooking vessel will rest a hay-stuffed cushion about 4 in. deep, and consisting of a board, cut to fit inside the box, to which is nailed a linen container stuffed with hay. The board comes uppermost and linen tapes are nailed to it as a means of easily lifting it out when required.

The stewpan is arranged in the cooker as shown, and is packed in hay, which should be stuffed fairly tight round the pan. The pan is placed so that when the wood-topped cushion is fitted over the pan, and the cover is closed, the cushion will fit tightly on the pan. The outside of the box may be stained and varnished or otherwise suitably finished.

Another Form of Self-cooker.—In using the self-cooker about to be described, instead of placing the vessel containing the food, at boiling-point, inside an insulated box, the process is reversed, and the insulator is placed over the saucepan, tea-cosy style. Several insulating materials have been tried and the following is their order of merit: Hand-picked feather-down, wool, cotton-wool (all very good), flock, old woollen cloth, felt, varnished newspaper, paper shavings, fine dry wood shavings, sawdust, hay, ordinary newspaper. All of these lose a great deal of their effectiveness if even slightly damp, and the cover must therefore be so constructed as to prevent the penetration of any steam or heated vapour arising from the enclosed saucepan into the insulating material. The saucepan may be of any shape or size. The one the writer has made, and which is now in daily use, is of strong tinplate. Its dimensions are: Height 6½ in., and diameter 6 in. It has two small handles made of tinplate bent in shape, and soldered on near the top of the saucepan. These handles are 2½ in. wide, and protrude only ¾ in., making the total width across the saucepan and handles 7½ in. Fold-down handles would be better, thus permitting the reduction of the necessary diameter of the cover by about 1 in. The cover of the saucepan can be made, or, to save trouble, purchased for a few pence at almost any ironmonger's. This cover with its handle will add about 2 in. to the height of the saucepan, bringing it to 8½ in.

The saucepan being complete, proceed with the construction of the insulated cover. The interior dimensions required to contain the above saucepan comfortably are, depth 9 in., and diameter 8 in. From a sheet of millboard of medium thickness cut a piece 30 in. long and full 9 in., say 9¼ in., wide. This will be long enough to give several inches of lap when it is rolled into a cylinder 8½ in. in diameter. Fasten the overlap with strong glue, and, when firmly united, using a fine awl for puncturing the holes and a darning needle and double thread, stitch both edges of this overlap firmly down to make sure that the cylinder will not open out. Now cut, marking first with a pair of compasses, a disc of millboard the merest trifle, say ¼ in., larger in diameter than the cylinder. Using the awl and double thread, stitch this firmly down to one end of the cylinder. The open end of the cylinder is now stiffened with a wire stitched round its outer edge.

Give both the outside and inside of the cylinder at least three coats of varnish thinned down sufficiently with turpentine to soak into the millboard. Resin dissolved in warm turpentine was used by the writer. When the last coat of the varnish is dry, proceed to wrap the cylinder round with the perfectly dry insulating material—sheet cotton-wool for preference—to a uniform thickness of from 1¼ in. to 1½ in. and the top or closed end to a depth of 2 in. To cover this will require a piece of old woollen cloth or preferably felt, large enough to go round and a little over, and a disc of the same material for the top. Secure this wrapping in place with twine, and then stitch the seam and edges with strong double thread, so that the insulating material is held tightly against the outside of the millboard cylinder.

The outside dimensions of the finished cover will be about, height 11 in., and diameter 10½ in. Of course, there is no objection to increasing the thickness of insulating material, but the amount stated gives excellent results.

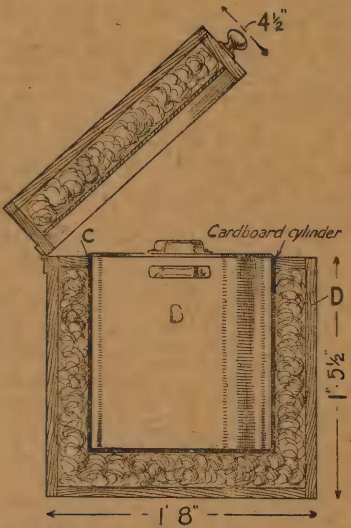


Fig. 2.—Section through Improved Hay-box Cooker, the Saucepan being a Jacketed Pan

It will now be necessary to make a square or round mat of five or six thicknesses of common felt, or of two thicknesses if padded with cotton-wool, and about 3 in. wider than the diameter of the insulated cover.

All that has to be done is to bring the food in the saucepan to full boiling-point over a gas jet or fire, allow it to continue boiling for five minutes, transfer it to the mat, and place the cover over it. Meat and almost all descriptions of vegetables will be perfectly cooked in an hour or less, with the advantage that things neither dry up nor boil over. Oatmeal thus cooked over-night is hot enough for consumption next morning. There is a great saving of gas, and a greater one in anxiety, the cooking requiring no further attention.

The cover will be greatly improved in appearance at very little cost, by neatly stitching round and on top of it thin dark brown American cloth. A final coat of white enamel may be given to the inside of the cylinder.

A self-cooker so made occupies little room, does not look untidy like the ordinary hay-box, which is a very indifferent insulator; and although the heat is not retained for the length of time it is in the chloride-of-calcium-lined double vessel described next in this chapter, it is cheaper to construct, and takes less space.

Improved Hay-box Self-cooker with Jacketed Saucepan.—It has already been stated in this chapter that the ordinary hay-box generally fails to *cook* food, although it will keep the food hot for a long time. The reason why it fails to cook is that nearly all foods require in cooking a temperature very nearly approaching the boiling-point of water (212° F. or 100° C.), and certainly not under 200° F. Now, although hay-packing is not a great heat absorbent, its volume is considerable, and its heat absorption is sufficient to lower the heat of the contents of the saucepan rapidly below 200° F. The insulating material (and air in the box) being now warmed, loss of heat in the saucepan proceeds much less rapidly; but the temperature having by this time fallen below the cooking-point, a warm but imperfectly cooked food is obtained. The following explanation shows how the defect may be entirely overcome. The principle rests with the great specific heat of a very strong solution of calcium chloride. Many jacketings other than calcium chloride have been tried, but no other chemical solution answers even nearly as well. Although a jacketing of melted suet has been used with a large evaporating pan with very good results, there is the danger of fire in its employment, and suet is not exactly a convenient material.

Fig. 2 represents a section through a self-cooker on the improved system here described, and Fig. 3 illustrates, in section, the special saucepan, which has an outer wall B and an inner wall A, the space between them being largely but not wholly occupied by a quantity of calcium chloride. The saucepan is lifted out of the box, the water and food to be cooked put into it, and it is placed on the range or gas burner until the water boils. It is then returned to the box, covered with its lid, and the hinged top of the box let down on it. Owing to the far greater specific heat of the calcium chloride solution, which occupies the space between the inner and the outer saucepans, steam continues to be evolved for a long time, and, in the attempt of the chloride to return to the solid condition, an amount of heat is liberated for hours, sufficient to keep the temperature of the inner saucepan up to, or almost up to, full boiling-point.

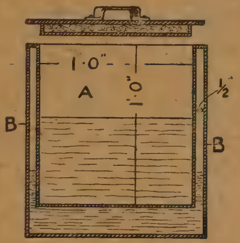


Fig. 3.—Section through Jacketed Saucepan

Figs. 2 to 4 clearly show the construction of the cooker, and anybody possessed of an elementary knowledge of woodwork and tinwork can make a good job of it. Ordinary match-boarding does very well for the box D, but the corners need to be stiffened with pieces of 1-in. square stuff. Thin or low-quality tinplate should not be used, being more difficult to work properly, more easily indented by a blow, and unable to stand the wear as well.

Make the two tinplate vessels first, then unite them firmly together with a ring of stout sheet tinplate at their upper edges. This is the only part of the work that requires special care to do neatly. After this is done, and not before, make a hole of ½ in. diameter through the ring, using the tang of a file or rasp or anything convenient. This hole is for pouring in the hot solution of calcium chloride, and also to allow for expansion and contraction of air in the otherwise sealed inner chamber. Before fitting the handles to the outside of the large saucepan B, take a length of moderately strong cardboard, and, using saucepan B as a mould, make a cardboard cylinder C of just such size as the saucepan B will freely lift in and out of without sticking. Make the cylinder a little too long and trim it when finished. Glue is used in making the cylinder. When dry, fit a cardboard bottom to it, using a large needle and an awl and some strong thread or fine twine. Then give it one or two coats of shellac spirit varnish to stiffen it and prevent it from absorbing any moisture from the steam or other causes. The object of the cylinder is to keep in place the crude cotton-wool, felt, or other non-conducting material with which the box is packed. The writer prefers the cheap quality of cotton-wool; but felt will do, and woollen rags, if clean and dry, may be substituted.

The insulating material should be filled in before nailing down the top of the box.

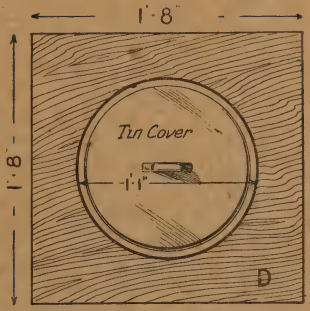


Fig. 4.—Plan of Improved Self-cooker

The wooden hollow cover of the box has the same thickness of non-conducting material.

The calcium chloride solution must be of the requisite strength—that is, it must not contain much more than its own weight of water. The requisite amount of water should be added, and the boiling solution poured, using a funnel, into the space between the two saucepans A and B, until it is about 7 in. deep (see Fig. 3).

If preferred, the calcium chloride can be made by pouring cheap commercial hydrochloric acid on limestone or marble chippings. When all action has ceased, add a couple of spoonfuls of whiting or chalk to ensure the last trace of acid being neutralised. (If perfectly neutral it will not rust the containing vessel even after several years.) The solution carefully decanted, or better filtered, is placed in any stewpan or enamelled-iron dish, and evaporated down over the fire or gas burner until a sample removed with a teaspoon goes solid after a few minutes' exposure to the air. Its boiling-point will be from 300° F. to 350° F.

The height of the solution is ascertained by passing a straight wire through the small hole left in the ring that unites the two saucepans. As the solution goes solid on cooling, this is very easy. Owing to the intense affinity of the calcium chloride for water, and the fact that the boiling-point of the strong solution recommended is from 280° F. to 300° F., there is no practical loss from evaporation. The upper surface of the box into which the saucepans fit may with advantage be covered with a piece of felt or old carpet nailed on, a hole being cut in the centre for the saucepan.

A very small piece of the cardboard cylinder will have to be removed on each side to allow for the handles, which must be placed as high up as possible; or they may be attached to the ring that unites the inner and outer saucepans.

These cookers maintain a steaming temperature for over forty-eight hours, and at the end of a week the interiors have been found still warm. (In practice, the calcium chloride solution does not rise to a greater temperature than 230° F., which is 18° higher than the boiling-point of water.) Anything—stewed or boiled meat, or any vegetables, even carrots which are considered slow to cook, porridge, any sort of milk puddings, boiled rice, etc.—cooks perfectly. The cover must be put over the saucepan the moment it is removed from the fire or gas. The cooker looks neat if covered with American cloth. The larger the size the longer the cooker retains its heat.

Making Shellac Varnishes

SHELLAC varnish is one of the oldest spirit varnishes known. The simplest recipe is a few ounces of shellac to 1 pt. of methylated spirit, the more the shellac the thicker being the resultant varnish. Shellac does not entirely dissolve in spirit, but a perfectly clear solution can generally be obtained by adding a little powdered lime and allowing the varnish to settle, after which a clear portion can be decantered. An excellent shellac water varnish can be made by dissolving 3 parts of shellac and 1 of borax in 25 parts of water, it being necessary to add a moderate amount of heat to effect solution. Shellac alone does not dissolve in water. Shellac is obtainable in two or three varieties, for example, the ordinary brown shellac, the white, or bleached, shellac, orange lac, etc. Bleached shellac is used in making the so-called white varnishes; a suitable recipe is powdered bleached shellac 2 oz., methylated spirit 1 pt. Orange lac dissolved in the same way produces a reddish varnish. Brown spirit varnish may consist of 4 oz. shellac and 1 oz. gum sandarach in 1 pt. of methylated spirit; when the solution is complete add 1½ oz. warm Venice turpentine, allow to stand, shake occasionally, and, after two or three weeks, strain or decant for use. For white hard spirit varnish, superior to the ordinary shellac varnish, use 4 oz. of the best gum sandarach in 1 pt. methylated spirit; in due course strain, and add 1 pt. of fine pale turpentine varnish. This is expensive. Spirit varnishes can be stained with any aniline dye soluble in spirit.

Gilding and Silvering Metals Non-electrically

THERE are one or two ways of depositing gold without the aid of a battery, but they are suitable, as a rule, only for ornaments that are not handled, such as clock mounts, photo mounts, etc., as the deposited metal cannot stand continual handling. In a later chapter full instructions on depositing gold and silver electrically are given; for the present, attention will be directed to the non-electrical methods.

Water Gilding.—The first method—water gilding—gives a fairly good deposit and will stand light burnishing or polishing. A bath that can be used over and over again until exhausted, and which gives excellent results in working, is prepared as follows: 30 gr. fine gold (24 carat) is dissolved in equal parts of nitric and muriatic acid, contained in a porcelain dish. It is then placed in a hot sand-bath (an iron plate or shallow basin filled with fine sand and placed over a source of heat), and evaporated until nothing remains but an oily-looking liquid at the bottom of the dish; this is chloride of gold. Add to it about a gill of water to dissolve it. Now dissolve 10 dwt. of potassium cyanide in ½ pt. of distilled water in a separate vessel. To this, add the chloride of gold, gently stirring; then 3 oz. of caustic potash and 1 oz. of bicarbonate of potash, which have previously been dissolved in distilled water, are added gradually. Make up with water to 3 pt., and boil in an enamelled saucepan for an hour. Allow to cool, and add water to make up the amount to the 3 pt. It works best at a temperature of 180° F., and may be enriched after working for some time by the addition of about 6 parts cyanide of potassium to 1 of gold chloride. It readily gilds small articles of brass, copper, or silver, the time taken being about 30 seconds. Larger articles should be first passed through a "quicking" solution, made by dissolving ½ oz. of red oxide of mercury in a solution of 1 oz. of potassium cyanide in 1 pt. of water, afterwards adding enough water to bring the quantity up to 2 qt. A dip into this solution is all that is necessary. Steel, iron, german silver, or nickel should be first coppered in a solution of sulphate of copper (1 oz. to 1 pt.) by simple immersion. Then lightly scratch-brush and pass into the gilding bath. Keep the articles moving while immersed and a good deposit will result, that is, sufficient to stand light scratch-brushing. Prepare the articles exactly as described in a later chapter for electro-gilding.

Fire and Mercury Gilding.—This is entirely different, and but little of it is done now. First make an amalgam by cutting into small pieces very thin gold sheet and adding it a little at a time to mercury, which has been prepared previously by heating in a porcelain cup over a small spirit-lamp flame, care being taken to prevent the vessel cracking. The proportions are 1 part gold and 4 parts mercury. Stir well with an iron spoon or skewer of new wood while adding the gold, until the two metals are thoroughly well mixed and until the whole mass becomes amalgamated into a thick paste. It is best to keep it in a basin of water until required for use.

The fumes arising while this job is being done are highly dangerous, and should not be inhaled ; the process is best performed under a hood or in a strong current of air. Care must be taken not to heat the mercury too much, as it is highly volatile. All excess of it in the amalgam should be squeezed out with the fingers and preserved for future use.

This amalgam is brushed over the bronze, copper, brass, or silver articles requiring gilding after they have been "quicked," using a brass wire brush which itself has been "quicked." This operation must be done very thoroughly, for if any portion remains uncovered the gilding is imperfect.

The article is cleaned and rinsed in clean water, and then placed in a furnace. It is important that a regular, steady heat be employed ; the construction of the furnace is immaterial, but the efficiency of the heating is of the greatest importance, for if under-heated the mercury will not be evaporated, and if over-heated the resulting colour will be patchy and unsatisfactory. A greenish-yellow colour results from a successful heating, and if on examination the job seems all right, give it a good scratch-brushing after cooling in water (see the chapters on electroplating elsewhere in this work). It is not, however, finished yet, but requires slightly heating again to make sure the mercury has been expelled. This method is better than over-heating at the first time. If satisfactory on a second examination, put it in a pickle of 1 part of hydrochloric acid to 6 parts of water, which will raise the tone of the colour. It must be taken out of this as soon as it reaches the rich colour of pure gold. It can now be finished in any way desired, and if it has been properly done there will be no fear of the gold rubbing off

For high-class work nothing short of electrical means can beat this method of gilding. If a furnace is too expensive, many a little job can be done on a shovel over a clear coke fire, but the heat must be quite uniform.

Silvering Pastes, etc.—All pastes and solutions used as substitutes for electro-silver plating have a chemical action on the metal to be coated ; they dissolve a portion of it and deposit an equivalent of silver in substitution. Consequently, immediately a very slight film of silver forms and the base metal is hidden, deposition must cease. Such preparations are, therefore, only imperfect substitutes for silver-plating, and can only be usefully employed where a silvered appearance is desired apart from considerations of wear and tear, as in the case of articles protected by glass or lacquer. The active ingredient in silvering pastes is silver chloride ; this is prepared by adding a solution of common salt to a solution of silver nitrate in distilled water until all the silver has been precipitated, then pouring off all excess solution from the white curdy silver chloride. This white paste may then be mixed with an equal bulk of powdered alum added to 8 parts each of common salt and cream of tartar ; or with an equal bulk of prepared chalk added to 3 parts of pearl-ash and $1\frac{1}{2}$ parts of common salt ; or the silver chloride may be mixed with six times its bulk of sodium hyposulphite.

In using the wet silvering paste thus prepared, it is rubbed on the previously cleaned metal with a piece of soft rag, and then polished with another piece of rag. A pad made with a bottle cork inside several folds of rag is useful.

The double salt of silver and sodium hyposulphite paste above mentioned may be dissolved in boiling water, and used in a liquid state to silver bunches of brass or copper trinkets by swilling and shaking them in the solution until they are white enough. They should then be swilled in clean hot water, and dried by friction in hot bran, hot sawdust, etc.

French Silvering Process.—Brass or any alloy containing copper can be silvered by the French silvering process as follows : Dissolve a stick of nitrate of silver in

½ pt. of water; add common salt, which will deposit the silver in a white mass at the bottom. Pour off the water and add fresh. Stir up, allow to settle, and pour off again. The residue is silver chloride, and this chemical should be kept in a blue bottle away from the light. To use it, clean the metal with fine emery cloth, wash it in cold water, and rub its surface with salt brine. Then rub it over with a rag on which is a paste composed of equal quantities each of silver chloride, cream of tartar, and water. Continue rubbing until it is evenly silvered all over, then wash in plenty of water and dry with a soft, clean cloth. Any silver chloride not used can be dried in the dark and kept in a bottle away from the light for future use. It is best to silver by gaslight or weak daylight. This process, of course, gives a mere film, but it is very white and keeps its colour well.

Other Solutions.—A solution, to be used boiling hot, is made as follows: Dissolve 10 oz. of silver nitrate in 5 pt. of distilled water, then add 60 oz. of potassium cyanide dissolved in hot distilled water. These solutions will only silver copper and its alloys; but thin films of silver can be deposited from them, because deposition ceases when the articles are coated with silver and thus protected from the chemical action of the solvent contained in the liquid. The following process of silvering is recommended: Take ½ oz. of nitrate of silver, and dissolve in distilled water. To this add a solution of common salt, which causes a precipitate of chloride of silver to fall to the bottom of the vessel. Pour off and wash the residue, afterwards dissolving in a solution of strong potassium cyanide, about ¼ lb. to 1 qt. of water, using just sufficient to dissolve, and making up to 1 gal. with water. Use at a temperature of 140° F. Keep the articles moving while in this solution. This is one of the simplest and best whitening solutions, and will readily cover most articles of copper or brass until the silver is exhausted, when it must be replaced.

Mercury Pastes.—Silvering pastes are sometimes made with salts of quicksilver or mercury in them, and these are said to be more certain in action than other pastes. But the white coat thus obtained soon turns black when exposed to air, and the mercury renders brass brittle and rotten. The mercury amalgamates with the metal on which the paste is spread; then in a few days the bright surface becomes tarnished and the metal becomes honeycombed and dull. Quicksilver is the common name for mercury, which is an entirely different metal from silver. Mercury is in a molten fluid condition at temperatures between 71° below the freezing-point of water. It then penetrates the pores of other metals, and mixes with them to form a peculiar kind of alloy named an amalgam. The amalgams of mercury with finely divided silver and gold have been, and are, used in silvering and gilding processes; as already noted the mercury sinks into the pores of the metal to which the amalgam is applied, and carries with it some of the fine particles of the metal with which it is alloyed, and it also forms an alloy with the surface particles of the metal covered with the amalgam. Hence, if the amalgam is simply rubbed into the surface of copper or brass, and allowed to remain thereon, a mercury-copper alloy which has a grey dull surface is formed. To avoid this action of mercury, it is necessary to heat the coated article to a temperature high enough to vaporise the mercury, but not enough to sink the coat of precious metal with which it was combined. Simple silvering processes containing quicksilver should therefore be avoided by all who value the strength of the metals they may wish to coat.

The Insertion and Withdrawal of Screws

PROBABLY no tool has less consideration extended to its construction or manipulation than has the indispensable screwdriver. Possibly the reason is that, like the hammer, almost anyone can use it. To drive home a screw looks easy enough, and, indeed, it is when everything is just right; but it is not quite so easy to

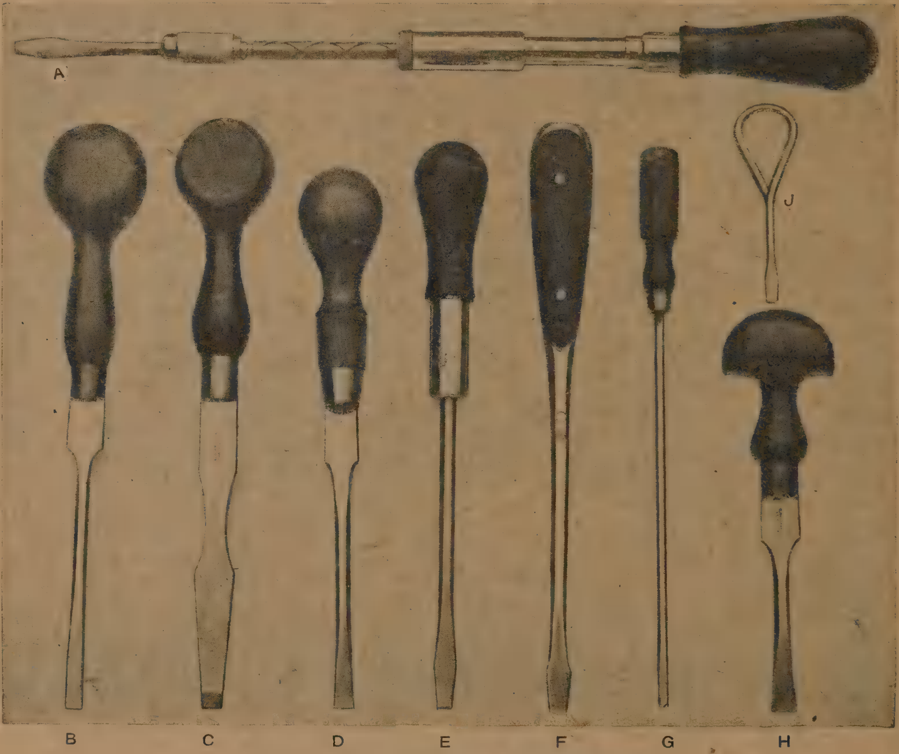


Fig. 1.—Various Patterns of Screwdrivers

remove a screw that is rusted in or broken in. Mutilation troubles, bad as they are in the case of " wood " screws (the ordinary steel screws for use in wood), are much more intensified in the various forms of countersunk screws used in machine parts and tools, especially where great holding pressure or frequent removal is required of them.

A screwdriver, like a spanner (for actually it is an internal one), should do its work by being placed in position, and then turned in the required direction, with the screw as its axis ; and if well formed and of a suitable shape it will not require a great amount of forward pressure while being so turned. On the other hand, if badly formed, the effort to keep it in its position in the nick of the screw will involve a great deal of pressure which correct construction would have obviated. The principal fault with most screwdrivers is at the point. Even otherwise good craftsmen, both amateur and professional, are often found working with a screwdriver so shaped as to necessitate an excessive expenditure of energy, the point being so shaped that the head of the screw is almost certain to be damaged, thus making its withdrawal in the future difficult. The edge is too frequently rounded off in all directions, somewhat as in Fig. 2, the angle at the point being so obtuse that great pressure must be applied to keep it in the screw nick. Fig. 3 shows a better shape, and if the steel is correctly tempered and kept in this form there is not much fault to be found with it, although it is not the best possible practice.

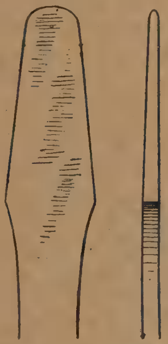


Fig. 2—Rounded Screwdriver Point

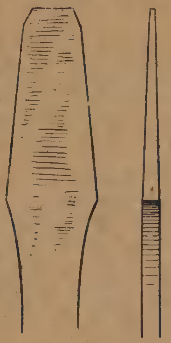


Fig. 3.—" Clipped " Screwdriver Point

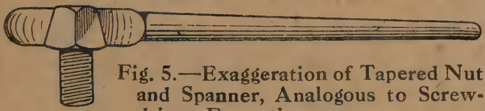


Fig. 5.—Exaggeration of Tapered Nut and Spanner, Analogous to Screwdriver Formation

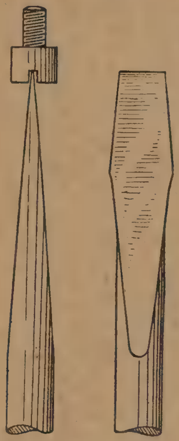


Fig. 4.—Chisel-shaped Point

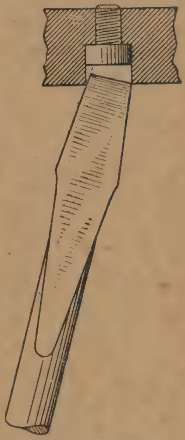


Fig. 6.—Difficulty in Using Screwdriver of Tapering Width

Perhaps the commonest error in blade formation is to grind it to a fairly sharp edge, as in Fig. 4. This blade, when inserted in a screw as shown, will require a great amount of forward pressure, for, on attempting to turn in either direction, it will tend both to slip out of the nick and score the work, and so bruise the head of the screw. It is possible that this chisel-shaped end is thought by some to be an advantage, because it accommodates itself to wide or narrow slits ; but it would be just as reasonable to form nuts and spanners of the shape shown in Fig. 5.

The shape shown in Fig. 6, where the blade is wider than the diameter of the head, is only objectionable, other considerations being good, when the head screws down flush with the surface of the work, which plainly will not admit of being done unless the tool is tilted as shown (and not always then), when, of course, the nick will suffer. There is also a risk of breaking the point of the tool.

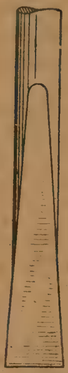


Fig. 7.—Wide Point: a Bad Shape

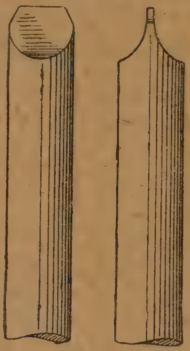


Fig. 8. — Most Efficient Shape of Point

Fig. 7 shows another defective form which is becoming much more common than it used to be. Being wider at the end than at any other part, it is liable to break, and there is a tendency to make the edge too sharp.

The most efficient screwdriver has a point shaped as in Fig. 8. There is no angle on the edge until it is clear of the screw head, so that little or no pressure is required to keep the edge of the tool in its place, provided the screw head has not already been spoilt. All the power of the driver is thus available for turning the screw, and this is all the more important when withdrawing a screw that has been in position for some time, because forward pressure militates against the desired end. An advantage of this form of edge is that it is no use as a stone chisel, so that one is not tempted to use it for jumping holes, which is the ruin of many screwdrivers. This shape is especially advantageous for screws of large size. Such a screwdriver as is shown in Fig. 8 should be made from a round steel spindle of a thickness equal to the diameter of the head of the screw for which the driver is to be used. The tang having been forged for the handle end, the other end is softened for working; this may be done by annealing, the point being heated to a dull red and cooled slowly in the ashes of the fire; but as good a result may be obtained at once by heating the point to a blood red and holding it in a dark corner until the glow just disappears and then cooling it in water. If the point is quenched the moment that it turns black it will be as soft as it can be made. The point can then be carefully shaped with the round side of a half-round file, keeping the edge or "point" as thick as is consistent with the size of the screw for which it is to be used, and making sure that it is quite parallel for at least the depth of the screw nick. This shape necessitates, of course, having a range of screwdrivers to suit various sizes of screws, but three drivers will be found to embrace most sizes of screws in general use. When the edge is properly shaped, heat it to a dull red and quench it in clean water, which will make the edge hard and brittle. Polish

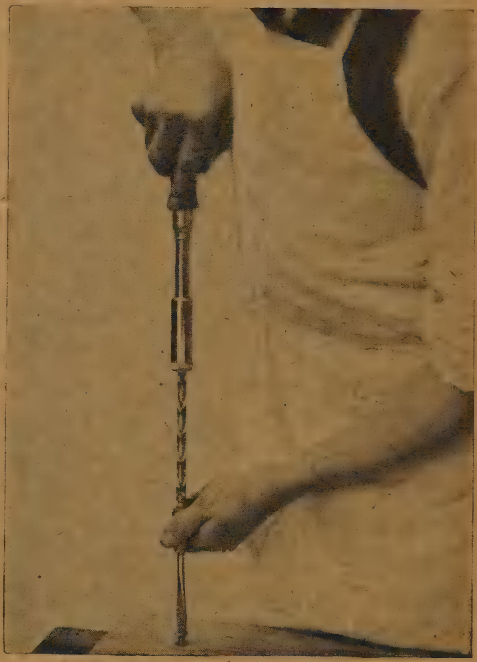


Fig. 9.—Using a Spiral Screwdriver

the filed parts with emery cloth until bright and hold the round part of the spindle, near the point, in the flame of a gas ring (in a good light) until the colour begins to show in the bright part; when the extreme edge assumes a tint between dark straw colour and blue, which is often called a "pigeon's-wing" colour, immediately quench. The tempering will vary a little with different brands of steel, and is largely a matter of experience or experiment. If the edge is too soft or too hard, a lighter or a bluer tint may be tried, until an edge is obtained that will keep its shape under any reasonable treatment.

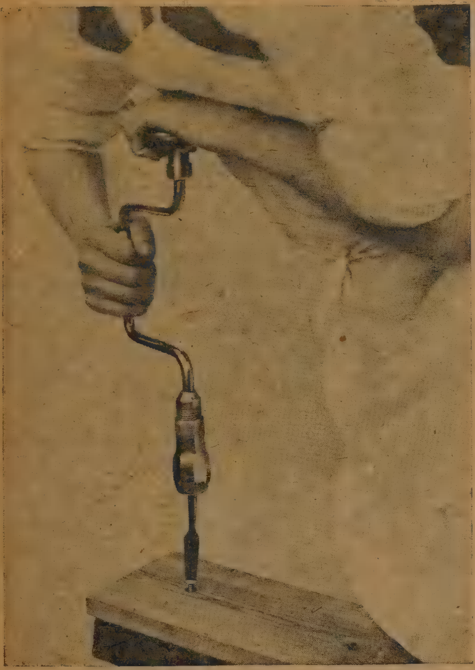


Fig. 10.—Using a Brace and Screwdriver Bit

Patterns of Screwdrivers.—Many and varied patterns of screwdrivers are obtainable, but no one of them is the best for all purposes. Fig. 1 is a photograph of a number of different kinds and may assist the amateur mechanic in arriving at a choice. C is the time-honoured flat-handled tool which is being ousted from its position by the oval-handled and spherical-handled drivers shown by B and D. A cylindrical handle is found, as a rule, only on a light screwdriver, such as that (G) used for small electrical appliances and typewriters. Fluting the handle gives a better grip. Round handles are also found on light ratchet tools of the "Yankee" type E, which, both in inserting and withdrawing a screw, allow of the handle rotating idly on the blade, which remains in the nick of the screw, the hand maintaining its grasp of the handle all the while; the alteration in direction of the drive is controlled by a little stud in the handle. H shows a very powerful type of tool, the overhanging handle allowing of great leverage being exerted; this pattern is used for tightening up the screws of plane irons, and is also a favourite with motorists. A well-made screwdriver, produced almost especially for motorists' use, is that shown by F; both blade and handle are forged in one piece, and the handle has

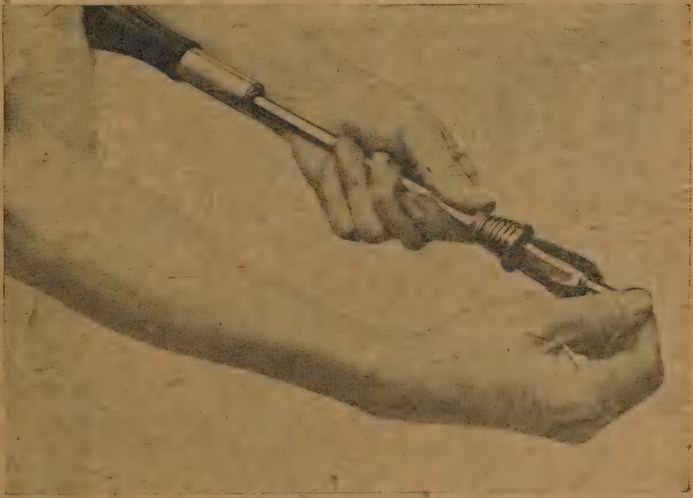


Fig. 11.—Using Screw Clip Attached to Ratchet Screwdriver

a wooden "scale" on each face; this construction obviates any possibility of such trouble arising as would occur if the wooden handle of the ordinary type of screwdriver were to give way or become loose and fall off. The width of the handle in this all-steel tool is not sufficient to give much leverage, and the tool will probably be a disappointment to woodworkers who try it for the first time. The little button-hook pattern driver shown at J is a convenient tool to have in the kit, it coming in handy for many a purpose for which the ordinary screwdriver would be too large or unwieldy, and possessing the advantage of costing only two or three pence. The American mechanic has become an adept in using the spiral ratchet screwdriver A, which works on the principle of the Archimedean drill. It answers well with small screws, but most English workers will prefer the ordinary solid screwdriver for stout ones or where the resistance is serious. Probably, however, it is a matter of practice and experience, since the American workman uses the spiral driver with complete ease. The saving in time when using the spiral driver on small screws is remarkable. All the holes are bored in readiness, all the screws are started with a light hammer blow each, and the spiral driver is then rapidly placed in position and the screws inserted simply by pressing forward the handle (see Fig. 9), the tool being steadied by holding the chuck with the other hand as shown.

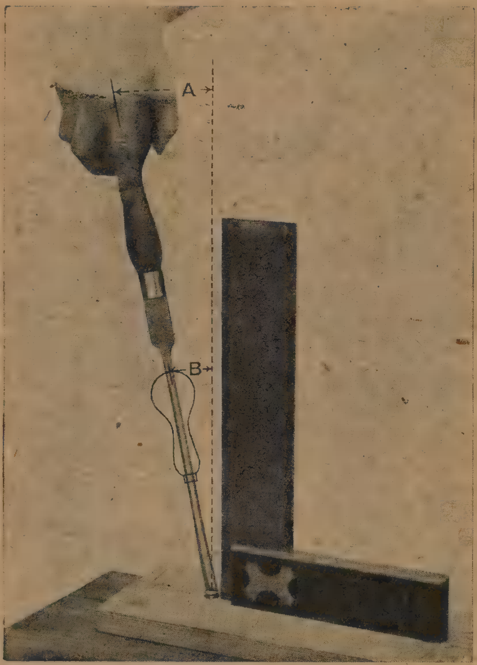


Fig. 12.—Showing Theoretical Advantage of Long Screwdriver on Occasion

The use of a screwdriver bit in a brace (see Fig. 10) provides an extremely powerful—sometimes too powerful—tool, the leverage obtained being very great. This combination answers well for the removal of stubborn screws, if the screw itself is strong enough to withstand the strain without breaking.

The combination of a clip with the ratchet screwdriver (see Fig. 11) (or screwdriver bit held in a ratchet brace) has its advantages. In attaching a screw, one hand presses the spring towards the point of the tool, while the fingers of the other hand insert the screw, as illustrated. The tool can be held by one hand only, and the screw driven home, the clip generally loosening its hold automatically when the screw is nearly in place; even should it not do so, a slight sideways pressure on the tool will release the screw.

A Long or a Short Screwdriver?—The idea that a screwdriver increases in power in proportion to its length is almost but not quite dead; but it is true that length is frequently an advantage. Most workers find that a long screwdriver is more easily held in direct line with the axis of the screw than a short one, and is therefore not so liable to come out of the nick. Then, too, it is generally easier to exert the whole of one's strength on a long tool than on a short one. Theoretically, the whole question resolves itself into what is the amount of leverage that can be exerted in turning the screw, and this depends, again theoretically, upon the width of the handle in relation to the width of the screw head. If one handle is 1½ in. in diameter, and another 3 in. in diameter, other things being equal, the former will require the application of twice as much effort as the latter. The reader must not conclude that one tool *creates* more power than does another. The whole of the energy required to drive the screw is supplied by the worker, and the same amount in the end is used up, whether a broad-handled or a narrow-handled driver be employed; but with one the energy is more conveniently expended than with the other.

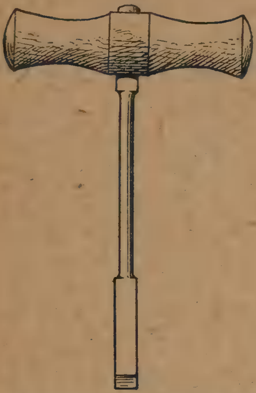


Fig. 13.—Gimlet-handled Screwdriver

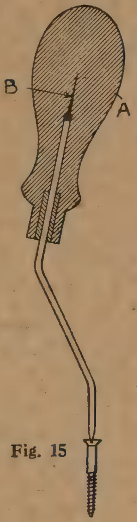


Fig. 15

Fig.15.—Revolving-handle Screwdriver

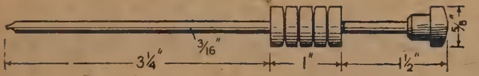


Fig. 14.—Convenient Screwdriver to Revolve in Palm of Hand

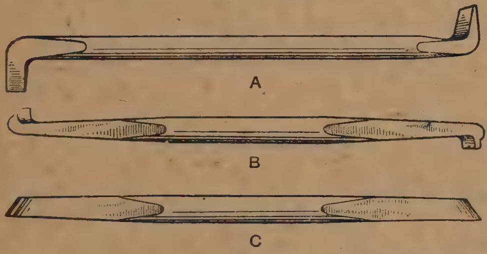


Fig. 16.—Screwdrivers for Use in Confined Position

Occasionally it may happen that more leverage can be exerted with a long driver than with a short one; and Fig. 12 shows how this occurs. When a long driver is slightly tilted (as in Fig. 12) in the effort to move a stubborn screw, the top of the handle goes some distance (see A) away from an imaginary vertical line running down through the centre of the screw. A short driver could not be safely tilted to a greater angle than a long one; and therefore the powers of the two tools should be proportionate to the lengths of the lines A and B (Fig. 12). However, should the worker try the experiment with two drivers of unequal lengths, his hand is unlikely to detect very much difference; and he will find that the tilting prevents the proper application of the turning effort, and is liable to cause the tool to slip or the head of the screw to be damaged—perhaps both.

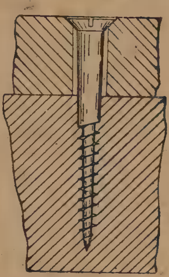


Fig. 16A.—Diagram Showing Cramping Action of Screw

Special Types of Small Screwdrivers.—A powerful little tool is the gimlet-pattern driver (Fig. 13), this resembling a gimlet, but having a screwdriver blade instead of a boring point; the T-handle provides great leverage.

For small screws the driver shown by Fig. 14 will be found very convenient. It may be made from a round rod of silver steel, and the size indicated in the illustration has proved useful. The top end is of brass and revolves in the palm of the hand, a groove round the rod and a small screwed pin in the neck keeping the head in place; the turning portion is a piece of brass or gunmetal bored to fit the rod and sweated on with solder. It can be milled on the surface with a coarse milling tool in the lathe, or have longitudinal grooves

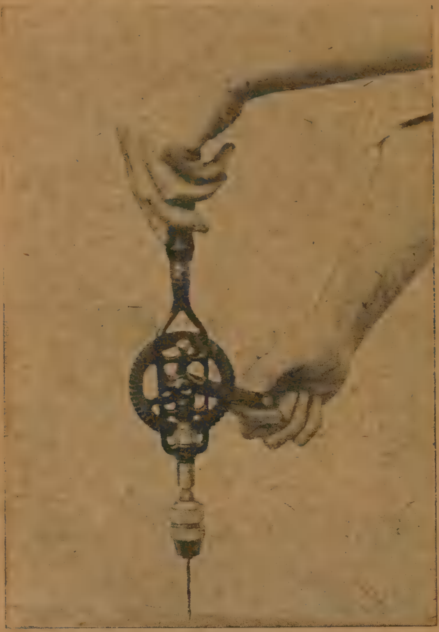


Fig. 17.—Using Hand Drill

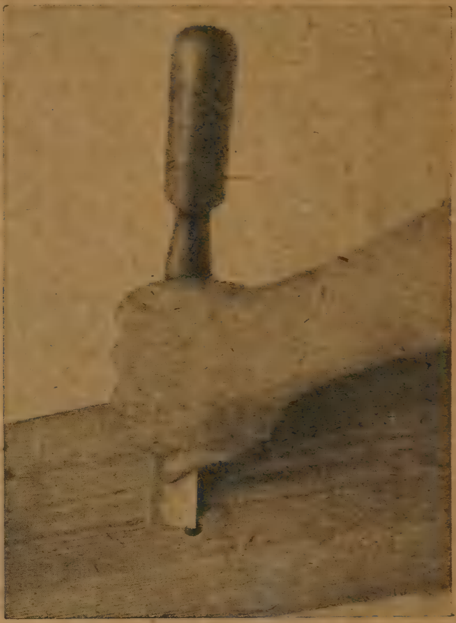


Fig. 18.—Countersinking Bored Hole with Chisel

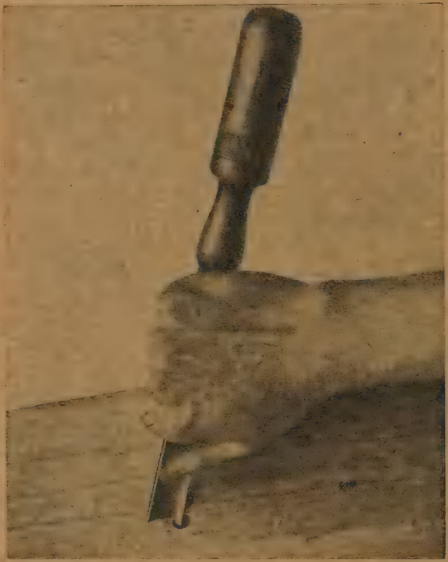


Fig. 19.—Countersinking Bored Hole with Gouge

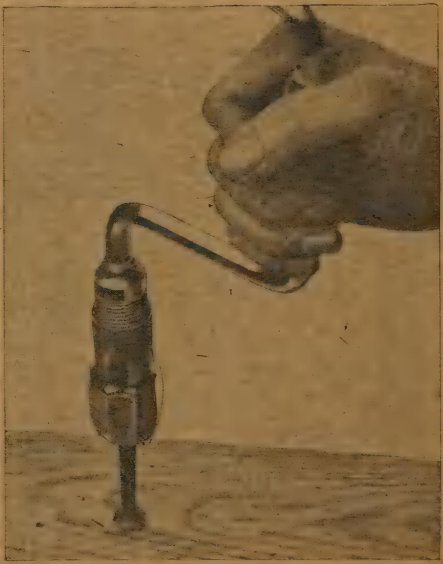


Fig. 20.—Countersinking Bored Hole with Rose Bit

filed in it with a screwhead file, which gives a good grip for the fingers. A great advantage with this form of driver is that while it has sufficient power to drive a No. 6 1-in. screw, one can feel better the power that is being exerted on a small screw, and is not so liable to overhaul it as when turning with the whole hand; one can also insert a screw in a confined position where an ordinary screwdriver would not answer.

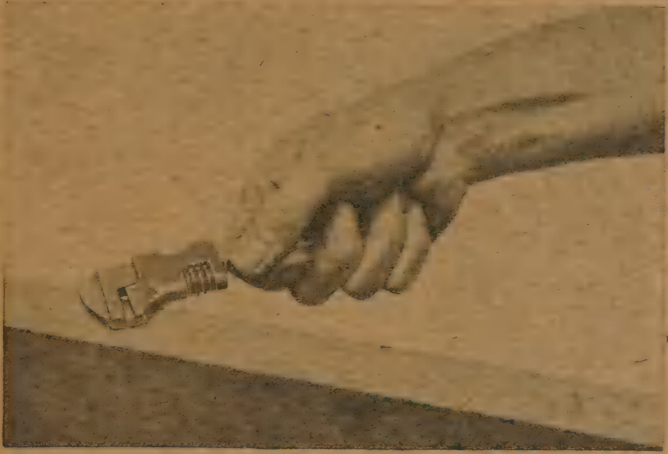


Fig. 21.—Removing Damaged Screw with Wrench

For inserting fine, long screws, an American has suggested the use of the curious little tool shown by Fig. 15. The cranked piece of steel wire revolves freely in the handle A, and its bearing is a small brad, B, that has been driven down the hole. The other end of the cranked wire is flattened as required. A number of wires with different-sized ends can be kept on hand, and interchanged as conditions require. In use, the tool is placed in the position shown, and the handle rapidly revolved.

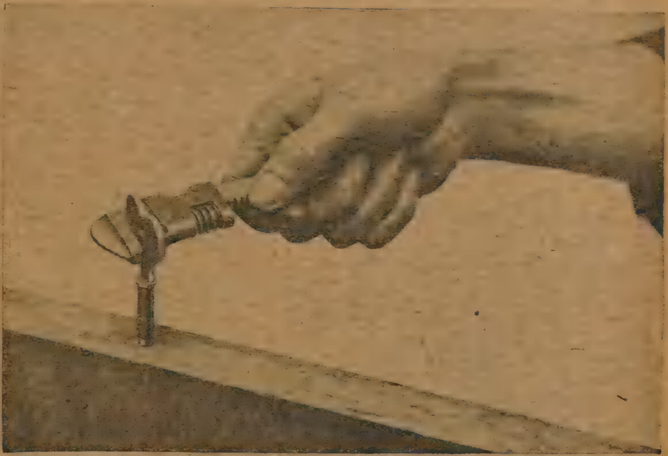


Fig. 22.—Removing Damaged Screw with Clock Key and Wrench

Screwdrivers for Confined Positions.—The cranked type of screwdriver shown by Fig. 16 is for use in confined positions where there is no room vertically for the ordinary kind. The requirement of this pattern is that the blades shall be so set on each end that they shall engage alternately with the nick of the screwhead at every quarter of its turn. Anyone who has used this tool as commonly made (see A) cannot fail to have noticed that the edge or point that runs at right angles to the length of the tool does its work much more conveniently and reliably than the opposite one running parallel to the length, this one being difficult to keep in the screwhead during manipulation. The improved form shown in plan and elevation by Fig. 16 is commended as possessing at both ends the advantages of the best of the old pattern.

Cramping Action of a Screw.—The screw is really a cramp, the cramping action taking place between the head and the thread. To ensure this cramping action, it is essential for the body of the screw to be an easy fit in the material next to the head of the screw as shown in Fig. 16A. The hole in the lower piece should be bored a shade smaller than the reduced stem of the screw at the bottom of the thread, so as to allow the thread to cut its own way. A well-greased screw is easily taken out at a future time.

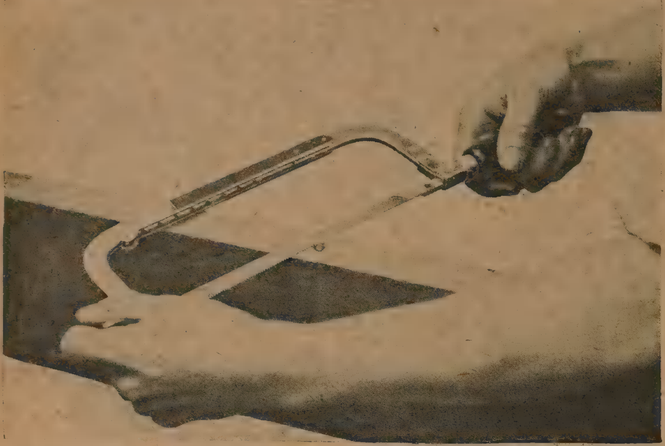


Fig. 23.—Cutting Off Old Screw with Hack-saw

Inserting a Screw in Woodwork.—But little need be said under this head except to emphasise the desirability of always boring an adequate hole for the screw first, this saving a great deal of hard work when actually driving in the screw. The small hand drills with bevel gear (Fig. 17) on sale at most tool shops are quite the most convenient boring tools for use in this connection compared with either gimlet or brace and bit ; they save a lot of time and their use is simplicity itself. All screwheads should be driven in flush with the surface of the woodwork, for which purpose the hole generally needs to be chamfered, which work may be done in one of two or three ways. Either a chisel or a gouge may be employed as in Figs. 18 and 19, always starting the cutting across the grain, or a rose bit in a brace or hand drill can be used as in Fig. 20.

Withdrawing Damaged Screws from Woodwork.—The subject of removing damaged or rusted screws from woodwork is of perennial interest to mechanics. Dealing first with screws of which part of the head has been broken off, and which may project from the work, there are one or two methods that may be adopted. One is to file the head so that it has two parallel faces, and then turn out the screw by means of a wrench, as shown in Fig. 21. Sometimes it answers to file the head of the screw square, and then to place over it a stout clock key, either turning the key with the fingers alone or with a wrench, as in Fig. 22 ;

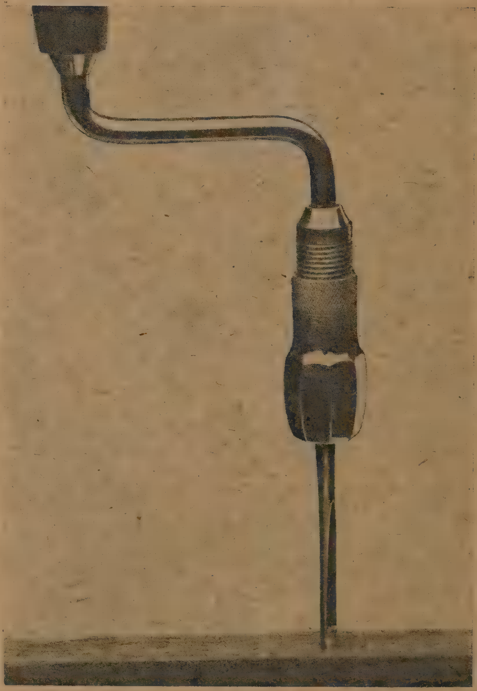


Fig. 24.—Boring Out Old Screw with Shell Bit

but the risk of breaking the key, unless it be of the old-fashioned stout variety, is appreciable. In some cases a projecting screw may be gripped strongly enough with a pair of pliers to allow of its being turned. Should these methods fail, the head of the screw may have to be hammered in or filed or sawn off (see Fig. 23), and a new screw inserted at the side of it; or the old screw may be removed by means of a steel bit in a brace as shown in Fig. 24, and the hole afterwards plugged.

In the case of a stout screw, a new nick may sometimes be formed by cutting with file or hack-saw, but frequently the attempt to turn the screw with a screwdriver will simply cause a further fracture, there being insufficient metal to give the requisite strength.

When the whole of the screw is embedded, and the head is too much damaged to allow of the screwdriver being used, it must be bored out.

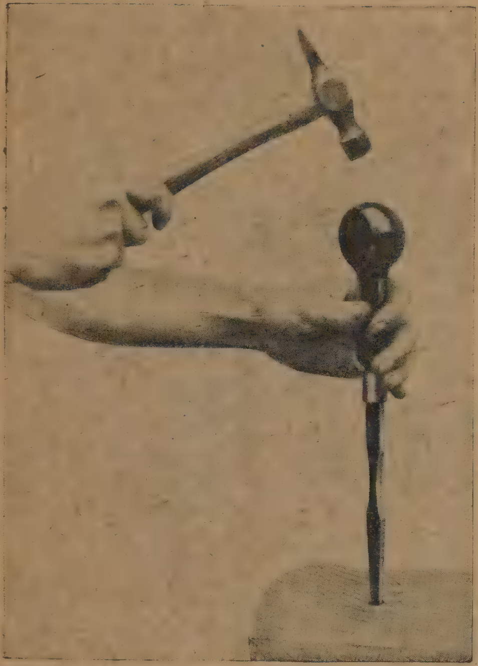


Fig. 25.—Starting Stubborn Screw with a Hammer Blow

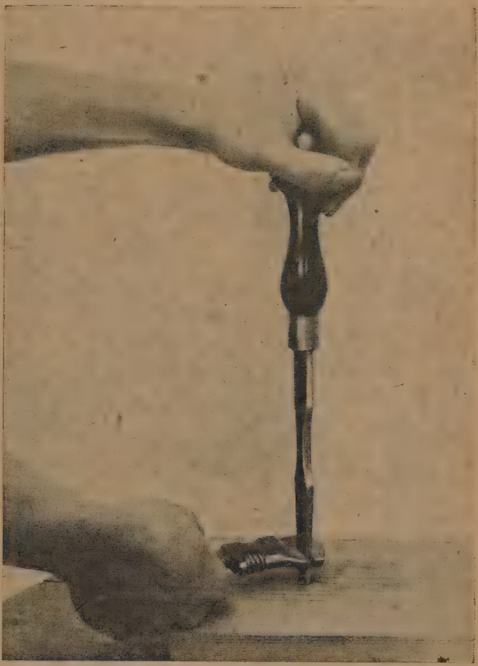


Fig. 26.—Obtaining Extra Leverage for Starting Stubborn Screw

Withdrawing Rusted Screws from Woodwork.—For starting rusted screws, the old method is to put the end of a red-hot poker or iron bar on the screw head and leave it there for a minute or so; the expansion of the screw due to the heat may break the rust contact between wood and metal, and allow of the screw being withdrawn. Still another method, and one which is frequently more convenient, is to place a stout screwdriver in position in the nick of the screw and give a smart hammer blow (see Fig. 25), thus driving in the screw ever so slightly farther and breaking the rust contact as before. Another method that frequently answers is to place the screwdriver in position, and then to force it round by means of a wrench applied as in Fig. 26, but there are certain disadvantages connected with this method; the screwdriver may not be able to stand the strain, in which case it will break; or more probably, especially in the case of an old and rusted screw, half the head of the screw will fly off, and should the job be the removal of a stout hinge a great deal of trouble will then have been caused.

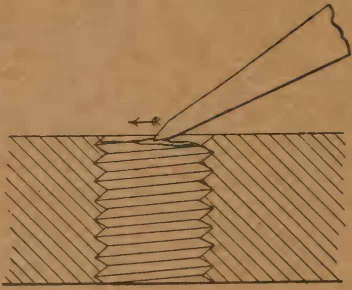


Fig. 27.—Turning Out Broken Screw with Blunt Chisel

REMOVING DAMAGED OR RUSTED SCREWS FROM METAL-WORK

This is the most troublesome job tnat the metal-worker has to deal with. It causes much waste of time, and if not done skilfully and effectively inflicts damage upon the work which is sometimes irreparable. Removal of screws by other than ordinary methods may be rendered necessary by the fact that the threads have rusted up, or that the head has been distorted or torn so much as to render the application of a screwdriver or spanner ineffectual, or the head has twisted off, or that the exposed portion of a stud has been bruised. Difficulty is also occasionally met with owing to the fact that someone has, through ignorance, tightened up a bolt or screw much too hard.

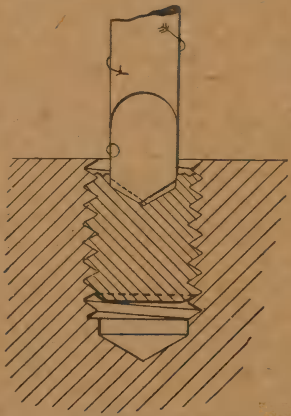


Fig. 28.—Drilling Screw with Left-handed Drill

In the case of a merely rusted or tight screw, which is not damaged, three principal methods may be adopted: (1) A thorough soaking with oil — preferably paraffin — which penetrates between the threads, softens the rust, and facilitates the unscrewing. (2) A white-hot iron applied to the head so as to expand it and slacken the fit. In the case of a tight nut, a heated ring, such as a larger nut, may be dropped over it for a while. (3) Vibration, produced by hammer blows, either on top of a head, or at the sides, oil having been previously soaked in. Vibration given simultaneously with a turning effort produced by a spanner or screwdriver is always to be recommended. Due caution is, of course, necessary when dealing with screws in cast-iron work.

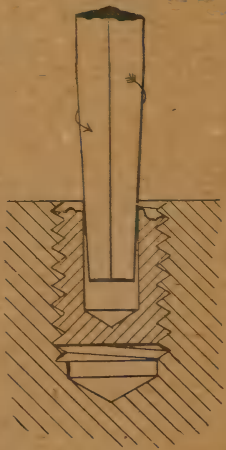


Fig. 29.—Turning Out Stump with Squared Drift

More difficulty is met with when there is no head, or only a portion of one, to obtain a grip on, or if a slotted head has its screwdriver slot pulled out of shape. If the size of head permits it is occasionally feasible to widen the slot out to a neat shape with a file and use a thicker screwdriver; but very often the requisite force which must be applied merely results in tearing off half the head. It is generally safer to grip the sides of the head with a pair of pliers or pincers, or in a vice, to twist the screw out. Or flats may be filed on the sides to apply a spanner or to afford a firmer grip for pliers or other tool. Spoiled studs can be dealt with in a similar manner, or a pipe wrench may be employed, or the well-known dodge of rolling a bit of rat-tail file in between the stud and the jaw of an ordinary spanner. In all these instances the screw or stud is spoiled and must be replaced by a new one.

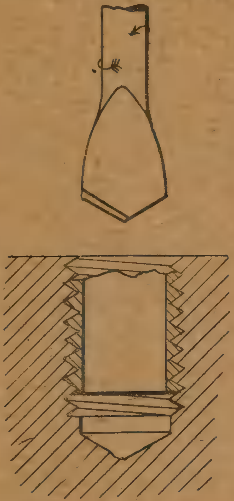


Fig. 30.—Stump Drilled Out to Leave a Thin Shell

If insufficient head is left to afford a grip, or the portion of head originally existing is twisted off in the attempts at extraction, it is usually necessary to resort to drilling, the alternative being to try rotation of the stump in the manner shown in Fig. 27 ; a blunt chisel or a centre-punch is held at a low angle, with its edge or point resting on the top of the stump as near as practicable to the outside diameter, and is driven with the hammer to turn the piece of screw around in the hole. Sometimes this method will succeed, the vibration of the blows giving considerable advantage, but if a screw is very tight it may fail, for the reason that the metal becomes expanded by the punching action, and tightens in the hole. Discretion must be exercised in trying this method. In some instances, chiefly in soft metals or alloys, it is possible to cut a nick in the top of the stump with a thin keen

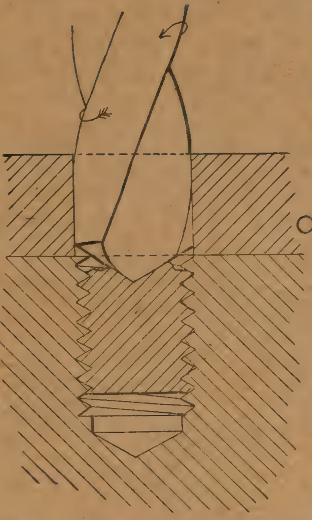


Fig. 31.—Method of Starting Hole Concentrically

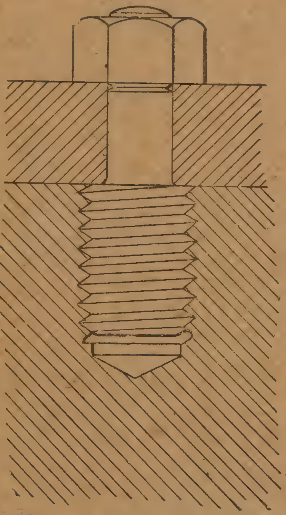


Fig. 32.—Special Stud to Fit Re-tapped Hole

chisel, so as to enable the chisel to be used subsequently as a screwdriver, applying considerable pressure on its head while turning; but this also may fail if the cutting swells the metal too quickly.

Drilling-out is the last resort that is available when neither of the foregoing methods succeeds. If done carefully it is a rapid way of extraction and offers the choice of about three different ways of removing the remaining portion of the stump. The best way is that shown in Fig. 28, in which a left-handed drill is utilised, and first sunk in for a short distance with a light feed. Then the pressure is greatly increased to make the cutting edges take a deep bite into the metal, so that the effect of further rotation is probably to start turning the stump to the left and winding it out of the hole. A stout, firm drill should be used, with thick point so as to withstand an unusually heavy feed without breaking, and it should not be tempered too hard. Should the drill snap, or fail to produce the required result, the method illustrated by Fig. 29 can be tried. Here a hole is drilled farther down, and a tempered piece of square steel of tapered form, with sharp corners, is driven lightly into the hole, so that the corners dig into the metal. The tool is then turned to the left with a tap-wrench or other means, and gives a powerful grip on the hollow stump.

The method shown by Fig. 30 is recommended for exceptionally tight screws or rusted ones where it is hopeless to try to twist them out. A drill is used (shown above the hole) very slightly smaller than the diameter of the root of the threads, thus leaving a mere shell in the hole, which shell can be still further weakened by slitting it partly through down the side at one or two places with a fine, thin-edged file. There is little difficulty then in breaking it up by applying a thin-edged chisel from the top, lightly driven in between the shell and the side of the hole, until the shell caves in. The chief risk in adopting this mode of drilling is that the drill may not start centrally, and in going to one side drills away part of the threads in the hole—an undesirable result. Care must therefore be observed to start the drilling accurately. If the top of the stump should happen to lie in a little way below the surface of the work, a twist or straight-fluted drill of the core diameter can be used with advantage in starting the countersink, because its body diameter is guided by the roots of the threads. A slightly smaller drill is then used to finish the hole. Or, in the case of a cover or other portion of work which receives the screw or stud sticking up from the hole, this cover may be utilised in the fashion of a drilling jig, as shown in Fig. 31. It is placed on and a couple of the other fastening screws or nuts tightened up to locate it properly, and then a drill of the full diameter is run in sufficiently to start a good recess for the following core-size drill.

In very bad examples of rusted or tight screws it may be found necessary to drill out all the piece of screw, with the result that the hole cannot be again utilised for the reception of a similar sized screw, but must be tapped out for the next size. Occasionally this fault is of no importance, but if it is necessary to keep the size of a stud and nut to match companion ones, the method illustrated by Fig. 32 can be followed. The tail of the stud is made large to suit the re-tapped hole, and the remaining portion is reduced to the same diameter as originally existing (see Fig. 32).

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Knots, Hitches, and Slings

THIS chapter will illustrate some of the correct methods of manipulating ropes and slings, and will describe how some of the most useful knots and hitches are tied.

Fig. 1 illustrates the correct method of tying the ends of two ropes, Fig. 2 showing the incorrect method. The latter is often referred to as the "granny" knot, and is almost sure to slip upon tension being applied to the rope ends. Fig. 3 is a modification of this type of knot, equally as safe as Fig. 1, the difference being in the disposition of the loose end A, which forms a binding lock when tightened.

Fig. 4 is a handy form of running noose or slip knot. If made thus, it will be non-slipping, but if tied in the form shown at Fig. 5 it is dangerous.

The bowline shown in Fig. 6 is perhaps the best of the many forms, as it is non-slipping. Fig. 7 shows the application of two half-hitches to a rope used as a guy. Fig. 8 illustrates how a bight is sometimes put into the middle of a rope. Whilst this method is a perfectly safe one, it possesses one undesirable quality—if much weight be suspended therefrom the knot is very difficult to untie afterwards.

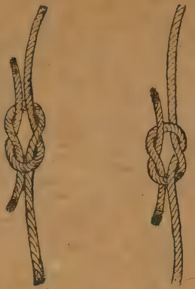
A much simpler, better, and equally safe bight is that shown in Figs. 9 and 10. To make it, the rope is caught up in the middle and given a half upward twist, bringing it into the loop shown in the first stage A of Fig. 9. The loop end is then taken in the left hand and again half twisted in an upward direction, bringing the centre of the loop half on each side of the upward portion of the standing rope. This is shown in the second stage B, in Fig. 9. Now take in each hand one of the loops and give them one complete twist in the same direction, finally bringing the two loops in a downward and forward position ready to receive the hook or tackle to be attached thereto. C and D (Fig. 10) show the third stage and the completed bight.

Fig. 11 is known as a sheepshank, and is used when it is desired to shorten a rope. The only thing to be observed when making it is that not less than 6 in. or 8 in. of folds extend beyond the half-hitches at each end.

Fig. 12 shows the basket hitch, which is a useful rig when wishing to sling many forms and shapes of work. It is made by joining two endless slings in a manner shown, its application being illustrated in Fig. 13.

Fig. 14 shows an arrangement that is useful when only a temporary suspension requires to be made. It is really stronger and safer than appearance would suggest, and, moreover, is frequently used, but the writer has not much faith in it.

Fig. 15 shows a method of satisfactorily suspending a round shaft when it is desired to maintain it in a vertical position, say, for fitting or trying in purposes. The alternative method in vogue is to



Figs. 1 and 2.—Correct and Incorrect Method of Tying Rope Ends

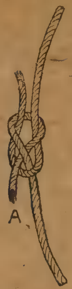
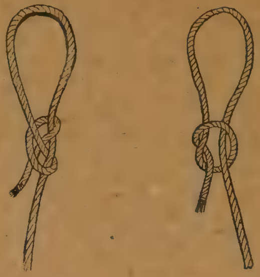


Fig. 3.—Another Safe Method of Tying Rope End



Figs. 4 and 5.—Safe and Unsafe Slip Knots

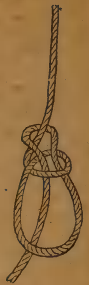


Fig. 6.—Bowline

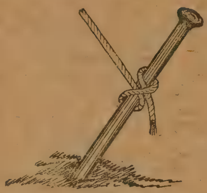


Fig. 7.—Two Half-hitches on Guy Rope

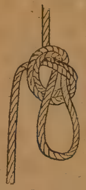


Fig. 8.—Bight in Middle of Rope

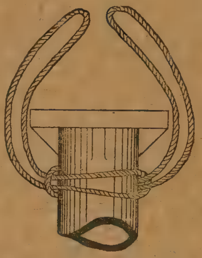


Fig. 13.—Using Basket Hitch

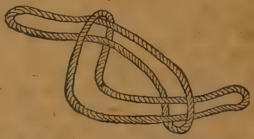


Fig. 12.—Basket Hitch

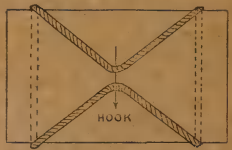


Fig. 17

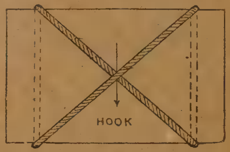
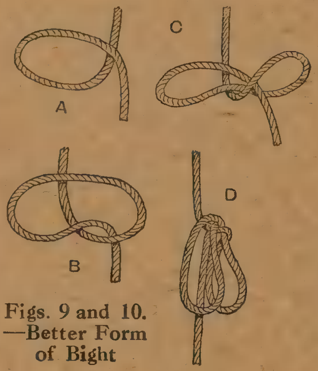


Fig. 18

Figs. 17 and 18.—Slinging a Block of Stone



Figs. 9 and 10.—Better Form of Bight

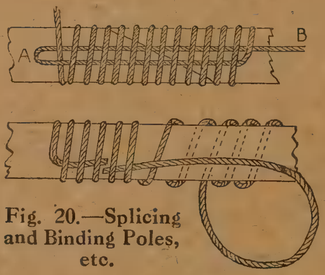


Fig. 20.—Splicing and Binding Poles, etc.

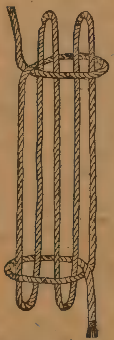


Fig. 11.—Sheepshank

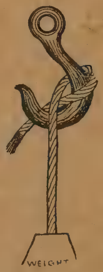


Fig. 14.—Hitch Round a Hook

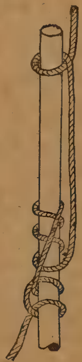


Fig. 15.—Suspending Round Shaft

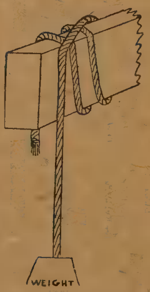


Fig. 16.—Suspending Weight Temporarily

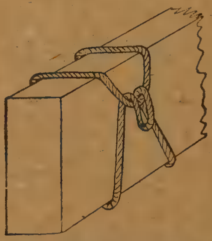


Fig. 19.—Rope Sling on Beam, etc.

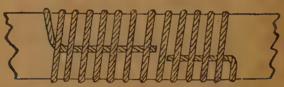


Fig. 21.—Binding a Pole

attach a pair of clips or a lathe carrier and sling with a rope; but the former, if tied as shown, is as safe and certainly a more speedy method than the latter.

Fig. 16 shows how a temporary hold may be made to a suspended weight over a beam or joist. This also is efficacious, but not fool-proof, and therefore should be used with caution.

In slinging a block of stone or a weighty casting, square or rectangular in section, it is usual to use the endless rope sling; but when doing so there is also in this a point to be observed, but frequently disregarded, when attaching it. The method to be avoided is shown in Fig. 17; if used thus, the weight is liable to shift or slip in the hook of the lifting tackle, and a much better way is illustrated in Fig. 18. By simply crossing or twisting the sling as shown, and inserting the hook in the direction indicated by the arrow—never the other way—the danger of slipping is averted.

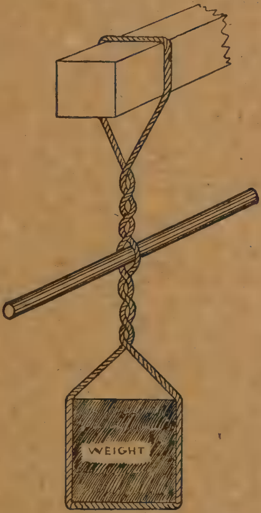


Fig. 23.—"Spanish Windlass"

Fig. 19 shows how a rope sling may be hung over a joist or beam in order to economise head room and make the most of the lift.

It sometimes happens that it is required to splice a cracked pole, lash together a jointed derrick, or bind a broken hammer, axe, or pick shaft. To combine strength with neatness it may be accomplished as in the first illustration of Fig. 20. Start binding by making the loop A the required length, then bind tightly and closely along until the end of the loop is reached. Pass the end of the string or rope through the loop, and by pulling at B the end will be pulled through into the binding, both ends being afterwards cut closely off.

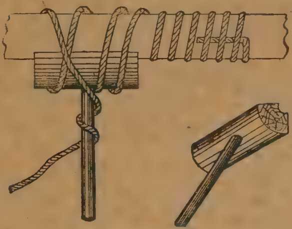


Fig. 22.—Serving or Whipping a Rope End

The second illustration in Fig. 20 shows another method of binding. In this there is no double loop to pull through, just the first and last ends after the coils are complete. This is shown in Fig. 21.

In Fig. 22 is shown how a rope end is "served" or "whipped." This is accomplished by means of the contrivance known nautically as the "serving board," and shown in the illustration. The method of using it is as shown. Tension is put on the binding by giving the loose end several turns round the instrument, the hollow in its underside fitting partly round the circumference of the rope. The whole is then given a rotative movement, with the rope as centre, until sufficient length of whipping is attained; the end of the cord is then passed backwards through the last half a dozen coils, the instrument removed, and each coil which is then slack individually tightened, and the last end pulled taut and cut off.

The "Spanish Windlass" is shown in Fig. 23. Much as this is despised for its crudeness and the fact that it tends to reduce a new rope to an old one, there are times when it is of the greatest use.

To preserve the life of a rope and render the rope safe under strains, it should be carefully coiled or folded up when out of use, and hung up in a dry place. Never let it lie slack on a damp floor, or keep it where it will be alternately dry and damp. Beware of mice and rats, which will work irreparable havoc with a rope in a single night, and do not put a rope away in a knotted condition, but untie each knot and give it a few smart blows across a hard floor, or block, in order to straighten out the fibres. Keep the ends whipped. Keep ropes as much as possible out of quicklime, oil and grease. Protect the strands, if lifting heavy castings or stones having sharp angles or corners, by interposing wood, sacking, or shavings. It is a wise precaution to examine every foot of a rope's length when taking it out of store, and also before putting it into use.

Making Dextrine Adhesives

THERE are three chief kinds of dextrine, (1 and 2) the common or commercial white and yellow, and (3) the extra pure. The last-mentioned costs about 2s. per lb., and is rarely used for adhesives, for which purpose the commoner kinds, costing about 4d. per lb., are good enough.

The kind of adhesive employed for postage stamps, envelope flaps and labels is made with: White dextrine, 2 oz.; dilute acetic acid, 1 oz.; water, 5 oz. ($\frac{1}{4}$ pt.); and methylated spirit, 1 oz. These are mixed in the order given. The gum is brushed rather thickly upon the paper and allowed to dry.

A common form of dextrine adhesive, which may be used in the same way as ordinary gum, consists of: White dextrine, 1 oz.; boiling distilled water, 3 oz.; and methylated spirit, $\frac{1}{2}$ oz. Stir till dissolved and strain through calico.

The whitish paste is the most popular form of dextrine adhesive, because of its efficacy and extreme cleanliness as a library or office paste and photographic mountant. The whole secret of making this kind of paste is to have the water, when mixing, at the correct temperature. One of the best-known commercial pastes consists of: White dextrine, $2\frac{3}{4}$ lb.; water, 2 qts.; oil of wintergreen and oil of clove, 13 minims each. Place the water in an enamelled saucepan, put over a gas-flame, and bring to a temperature of 160° F., no more and no less. Stir in the powdered dextrine very slowly, and take particular care not to let the temperature vary more than 1° either way until the whole of the dextrine has dissolved to form a perfectly clear solution. At the temperature stated, the dextrine undergoes certain changes. As soon as the dextrine has passed into solution, add the essential oils very slowly, stirring all the time; then allow the solution to cool slightly, and pour into wide-necked bottles, to be immediately closed with corks or screw-tops. The adhesive at this stage has the appearance of gum. The filled bottles and jars should be set aside for about a fortnight. The paste sets slowly, and in time congeals, becoming of a perfectly white colour, and possessing the firm consistency that is characteristic of the commercial pastes. If too stiff, add a little water, and work it round with a brush. The paste becomes almost as hard as chalk if exposed to the air for a period. In course of time, the preparation develops cracks and becomes unusable; when this happens, add a little water, stand the jar or bottle in a saucepan of cold water, and heat until the mixture melts and loses its whiteness; if stood aside for a week the whiteness returns, when the mixture will be as good as new.

A Home-built Printing Press

AMATEUR printing is fascinating work, but it requires more initial outlay than the average hobby, and its first results are liable to be disappointing.

The first essential of a printing press is that it be capable of giving a steady, firm and strong pressure. Another condition is that the bed be firm; thus wood is not satisfactory for the type to stand on, and this also applies to the platen, though in a less degree. The bed and platen must, when they come together to make the impression, be as nearly parallel as possible, otherwise the impression will be uneven, the type being nearly forced through the paper in some places, and scarcely touching it in others.

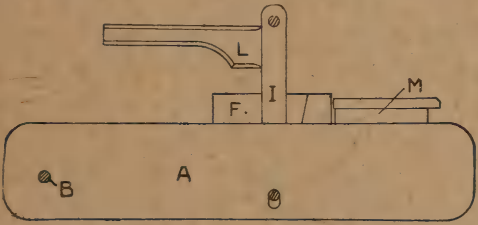


Fig. 1.—Side Elevation of Press with Impression On

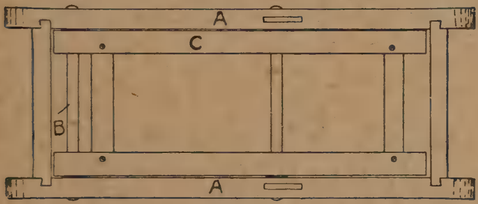


Fig. 3.—Plan of Press with Levers and Bed Removed

Another source of disappointment is the size of the press. This should be at least capable of printing on large notepaper—that is, the actual type surface should not be less than 7 in. by 5 in.; and an iron press to print this size will be found expensive.

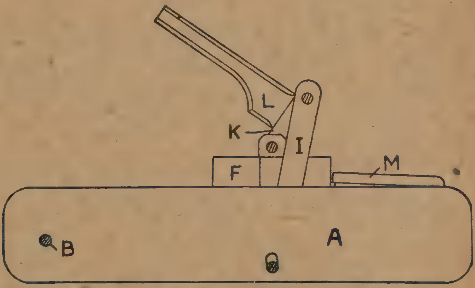


Fig. 2.—Side Elevation of Press with Impression Off

No home-made machine constructed largely of wood will equal one made of iron throughout, the principal failing being the speed at which it can be worked. But as an amateur has rarely anything approaching a long run to do, this need not enter into his calculations.

It is impossible for the ordinary amateur to make a machine on the lines of the iron presses sold, on account of the bearings needed, and this will explain the totally different appearance of the one illustrated in this chapter from those used in the trade.

The photographs here reproduced were taken from a model made for the purpose, and in some slight respects they differ from the line drawings. The reason for this is that as the model progressed towards completion, various improvements suggested themselves, and these have been embodied. Fig. 1 is a side elevation of the press with the impression on, and Fig. 2 a similar view but with the impression off. Fig. 3 is a plan with the bed, platen, and impression apparatus removed, and Figs. 4 and 5 are sections through the press lengthwise, with impression off and on respectively, but without the levers. Figs. 6 and 7 are photographic views showing the press in its two positions.

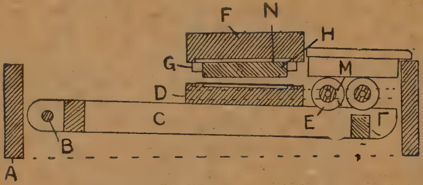


Fig. 4.—Section of Press with Impression Off

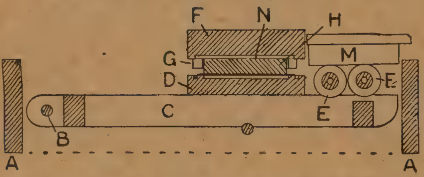


Fig. 5.—Section of Press with Impression On

The Action Explained.—The rectangular frame A is what may be called the frame of the press, in which is pivoted by means of the bar B, the lifting frame C, on which rests the platen D, to which are attached the inking rollers E. On the frame A is fixed the type bed F, to which is attached by clips the chase G, in which the type H is firmly wedged (or "locked up") for printing.

The bars I are pivoted to the sides of A, near the bottom, and work in slots made for the purpose, and at the top they are pivoted to the short bars K, which at the bottom ends are fixed in blocks screwed to the upper side of the bed. Between the two bars K is fixed a solid block, to which the hand lever L is screwed, and the latter is also pierced by the bar at the top which connects the two levers, forming together a very powerful toggle joint, the action of which will be best understood by the aid of the reproduced photographs (Figs. 6 and 7).

In printing, the action is as follows: With the lever L raised as in Fig. 2, the platen is drawn forward to the left-hand end of the press, which causes the rollers to pass under the type, thus giving the latter a slight coating of ink. The paper to be printed on is laid on the platen D, and the whole pushed along to the other end of the frame, thus bringing the paper under the type. The lever L is then depressed, bringing it into the position shown in Fig. 1, which lifts the frame C and presses the paper with great force on to the type, and prints the matter set up. The rollers at the same time have passed along under the ink table M, thus obtaining a fresh supply of ink for the next impression.

Objection may be taken to the fact that the type being above the platen is liable to fall out. This, however, is a fallacy, as unless the type is imposed so that it is quite firm and solid, the loose letters would be drawn out by the suction of the rollers even if standing with the printing face uppermost. The fact of its being when in use face downwards makes no difference whatever in practice.

The Frame.—The first part to make is the frame (Fig. 8), the sizes of which are given in Fig. 9. This may be made in deal, but if the cost is not prohibitive, it will be all the better if made in hardwood. The ends have a dovetail formed on them the full width, and the sides are dovetail slotted to suit. The whole then drives together tightly, and a few nails in each if soft wood is used, or glue only if hardwood, will fix all together.

Lifting Frame.—The lifting frame C is shown complete in Fig. 10. The length and width of this must be such as to allow of its fitting closely inside the frame A. It consists of the two sides, which must be mortised to take the ends as in Fig 11, and the two ends which are tenoned to fit into the sides as in Figs. 12 and 13. The former is less in depth than the other and the sides, to give room for the inking rollers to pass over it. This frame is best fixed together with pins as shown, and the tenons may be wedged as well. It is important that it be strong and firm when finished. The rounding of the ends of both the above frames is a matter of appearance only.

Bed.—The bed of the press F is a solid piece of wood of sufficient length to reach across the frame A, to the sides of which it is screwed; and, as previously mentioned, wood is not a suitable surface for the bottom of the type to press against if good work is wanted. The surface is cut away, and a piece of plate-glass N bedded in with plaster-of-paris. If bedded firmly there is not the least risk of the glass breaking.

The bed must be cut away at each end to allow the bar I to oscillate to and fro.

The pivoting of the lifting frame C must not be done yet, or it may be found that it is too high or too low.

The Platen.—The part to make next is the platen D. This must be the right size to fit easily but closely between the sides of A, and the width must be the same as the bed F. A piece of plate-glass is bedded in to coincide with that in the bed, and along each side is made a narrow channel as shown in the sectional illustrations. These channels are to take strips of iron or brass which will hold the paper and "blanket," with which the platen will have to be covered for the actual process of printing.

In the ends of the platen must be made channels about $\frac{3}{4}$ in. wide by $\frac{1}{8}$ in deep, to take strips of iron or brass (see the dotted lines in Fig. 4, and O, Fig. 14). These strips form the bearings for the inking rollers, holes being drilled in them for the purpose. The channels in the ends of the platen in which these bearers fit must not be made parallel to the face, but low at the back end and higher at the front end. The dotted lines in Fig. 4 and the reproduced photograph (Fig. 15) show what is required.

As there will be considerable friction between the underside of the platen and the top of the lifting frame C, it will be advisable to insert strips of metal along the latter and also in the former. This will not only prevent wear, but will make the operation of the press much easier.

Adjusting Lifting Frame.—The adjustment of the lifting frame C can now be made. To do this, prepare a block the size of the sheets of plate-glass in the bed and the platen, by barely 1 in. thick; it must be quite parallel. Clamp the bed, the above block, the platen and the lifting frame together tightly, with the bed screwed in its position on the frame; and while held together thus, bore through the sides of A and the lifting frame at the back end of the press, and insert the bar B. Then unclamp and remove the block, when the platen should slide to and fro on the lifting frame, and the latter should lift and drop easily at the front end.

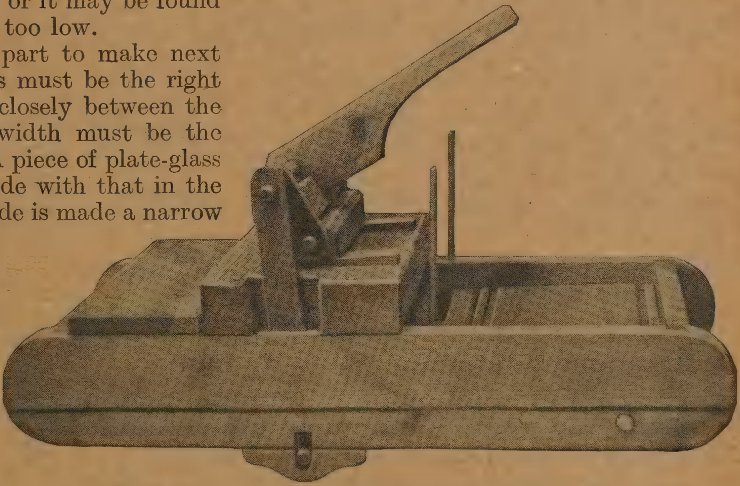


Fig. 6.—View of Press with Impression Off

Part Assembling.—It is as well now to put the press together rather than have too many loose pieces scattered about. The dimensioned diagram (Fig. 9) shows the position of the bed on the frame, also the mortises in which the long toggle bars work. The latter should be made first, and the bed cut away to correspond, so that when the pressure is put on by the lever, the side of the recess in the bed will act as a stop to prevent the lever being depressed too far, and thus spoiling the work.

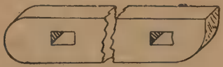


Fig. 11.—Mortised Ends of Lifting Frame

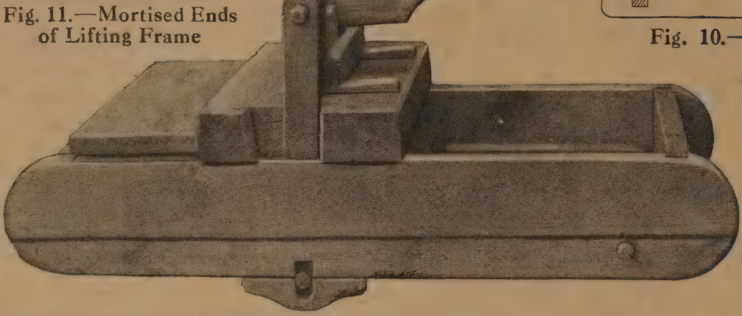


Fig. 7.—View of Press with Impression On

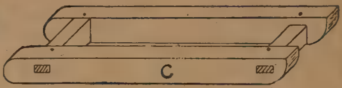


Fig. 10.—Lifting Frame

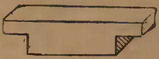


Fig. 12

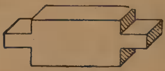


Fig. 13

Figs. 12 and 13.—Left-hand and Right-hand Cross-pieces of Lifting Frame

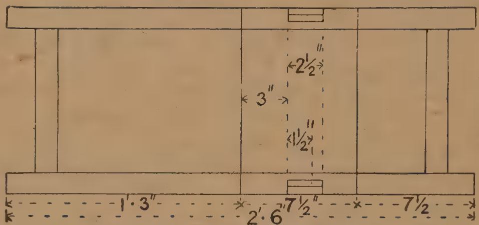


Fig. 9.—Dimensioned Plan of Frame

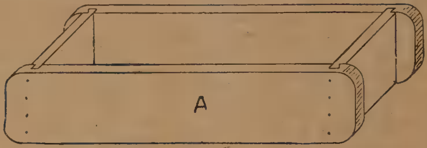


Fig. 8.—Frame of Press

Fig. 15.—Platen with Roller Bearings and Roller

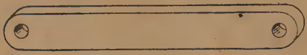


Fig. 16.—Long Toggle Bar

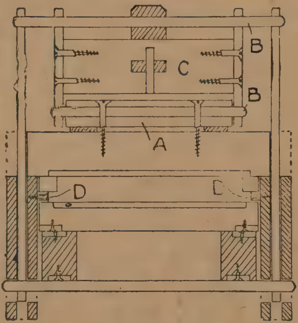


Fig. 17.—Cross Section through Press

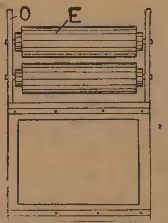


Fig. 14.—Platen with Rollers

The frame A, lifting frame C, and the bed may next be prepared; but they are not yet fixed together permanently.

The bed can be firmly screwed to the frame of the press, and then the long bars (Fig. 16) may be prepared, the length from centre to centre of the hole being 11½ in. The holes should be drilled to take ½-in. round steel rods; these rods should be made to fit as closely as possible, but without being tight.

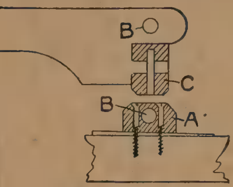


Fig. 18.—Details of Lever, etc.

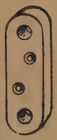


Fig. 19.—Short Toggle Bar

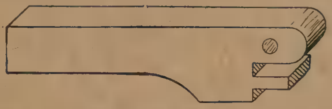
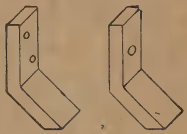


Fig. 20.—Lever


Figs. 21 and 22.—Fixed and Movable Chase Clips

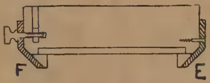


Fig. 23.—Section Through Bed

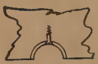


Fig. 27.—Section Through Half-tube Bearing

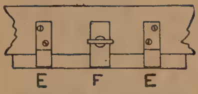


Fig. 25.—Method of Fixing Clips

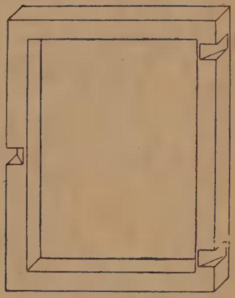


Fig. 26.—Chase with Filed Bevels for Clips

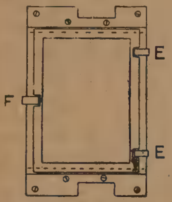


Fig. 24.—Under-side of Bed

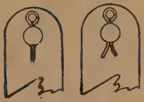


Fig. 30.—Split Pin in Position

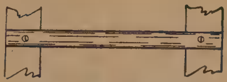


Fig. 28.—Plan of Half-tube Bearing

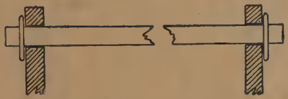


Fig. 29.—Bars with Split Pins

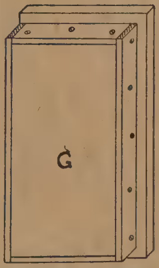


Fig. 31.—Ink Table

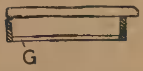


Fig. 32.—Section Through Ink Table

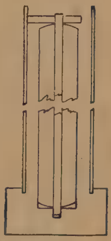


Fig. 34.—Roller Core in Mould for Casting

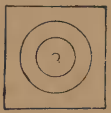


Fig. 35.—Block Forming Base of Roller Mould

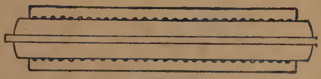


Fig. 33.—Section Through Inking Roller

Fig. 17 is a complete section across the press when the impression is on, and Fig. 18 is a sectional detail of the lever and adjacent fittings. The block A is screwed to the top of the bed, and has a hole B completely through it endwise to take the lower round bar. It is planed slightly at an angle on the under-side, and two tapered wedges are placed between it and the bed as shown in Figs. 17 and 18. These wedges form a means of adjusting the impression according to the class of work being done on the press. The block must be sufficiently wide to allow of screws being inserted on both sides of the bar as in Fig. 18, it being absolutely necessary that it be perfectly firm and solid.

Toggle Bars and Other Details.—To find the length of the short toggle bars, the block which was held between the bed and the platen to find the position of the bar on which the lifting frame pivots should be again placed in position, and the parts pressed together. The distance from centre to centre of the bars B (Fig. 17) can then be taken, and the bars made to this length as in Fig. 19. These short toggle bars must also be drilled for screws for fixing to the block C, the length of which can be found after adjustment. The width is not particular to a trifle, but the thickness should be the same as the width of the bars.

This block should be mortised to take the lever as shown in Fig. 18, and the lever itself must not only be tenoned into the block and fixed with a pin, but the upper part should be continued, so that the top bar B can pass through it as shown. The lever itself is shown by Fig. 20. The corners of the blocks A and C must be chamfered off as shown in Fig. 18, or they will come in contact when worked.

Small strips of metal must be screwed to the same sides as at D Fig. 17, for the chase to slide on; but as these will not hold it sufficiently firm, other means of fixing (as already mentioned) must be resorted to. These take the form of metal clips as in Figs. 21 and 22; two of the former are wanted, and only one of the latter. The former are screwed to the back edge of the bed as at E (Figs. 23 and 24), the chase being filed away so as to fit into them. The single clip is movable; its position is in the middle of the front edge of the bed F, where it is fixed as required by a thumbscrew working in a buried nut, as shown in section in Fig. 23. Fig. 25 shows the three of these clips as fixed, not as they would be in practice, which is shown in Figs. 23 and 24. The height of the clips must be such that the act of screwing in the thumbscrew will force the chase up to the bed tightly, and hold it firmly. The chase, with the angles filed away to take the clips, is shown in Fig. 26.

The strips of metal to prevent wear on the top of the lifting frame and on the under-side of the platen are shown in position in Fig. 17, also other strips to take the pressure of the lower bar under the lifting frame. A good plan in respect to the latter is to split a brass tube of the correct diameter, and screw it to the sides of the lifting frame in the position required (see Figs. 27 and 28). The bar will then work in this very smoothly, and there will be practically neither wear nor tear.

The various round bars have been shown as only just passing through the different members in which they work, and there is really not much fear of their working out endwise. But if the trouble is not too great, it is better to allow the bars to run through about $\frac{1}{2}$ in., drill them with a $\frac{1}{8}$-in. hole, and insert small split pins, as shown in Figs. 29 and 30, thus making assurance doubly sure. In the case of the bottom bars, where the split pins would be against wood, it is best to use a steel washer, and these should also be used between the lifting frame and the inside of the frame sides.

Inking Table.—The inking table as seen from underneath is shown in Fig. 31, and a cross section in Fig. 32. The smaller part drops into the frame behind the bed, the larger part simply acting as a stop. The main part consists of wood; but this is faced with plate-glass G, the strips round holding this tightly in place. A glass surface is an ideal one for ink, and is easily cleaned, while the ink does not readily dry on it.

Inking Rollers.—The inking rollers consist of three parts as shown in section by Fig. 33: the iron centre, which also acts as the spindle, the wooden core, and the composition outside. The first should be a round iron or steel rod $\frac{1}{4}$ in. in diameter; the second is also round, 1 in. in diameter; and the last makes up the roller to 2 in. diameter, the required size. The rollers are cast in a piece of brass tube, smooth on the inside. This tube is mounted in a block as Fig. 34, which has three holes of varying depth and size bored in it, one each to fit the tube, the core, and the spindle. The block in plan is shown by Fig. 35. At the top of the tube, to ensure the roller being true, is fitted a piece of wood or metal as Fig. 36, the cut-out piece being for the pouring in of the composition.

Before casting the roller the core should have stout string tightly wrapped round it, as in Fig. 33. If this is neglected the composition will get loose and ultimately peel off. To make the roller leave the mould easily when set, the latter must be well oiled, but all oil must be wiped out, or faulty rollers will result. The roller composition is best purchased ready for use; it will then only be necessary to melt it in a glue-pot and pour it into the mould.

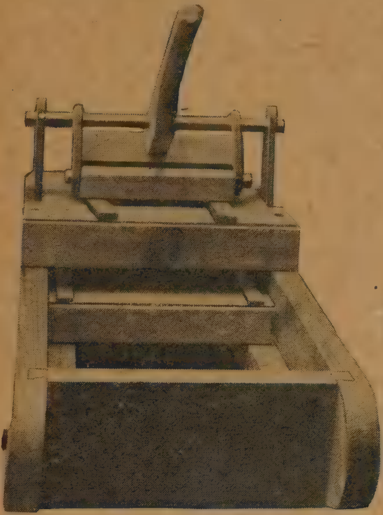


Fig. 37.—End View of Printing Press

When the press is not in use, the rollers should be kept in an airtight box to prevent the ink drying on them.

Grippers.—Fig. 37 is a view of the press end on, and in this, as well as in the other photographs, are shown strips of wood lying on the platen. These are the grippers, which pull the paper away from the type as the platen drops after the impression is taken. They are fixed to a pivoted bar at the back of the platen as in Fig. 38, the method of fixing being by screws as shown in Fig. 15. These grippers should really be strips of metal, and if bent up at the points as in Fig. 38, they will act with more certainty. It is necessary that the grippers should rise out of the way to allow the printed sheet to be taken off and another sheet laid on; and this is effected by inserting the pin H in the bar and another in the frame side, the contact of these raising the strips at the right time (see Fig. 39).

If printing very thin paper, the wedges on top of the bed will require pushing in slightly; but for cards the reverse is the case.

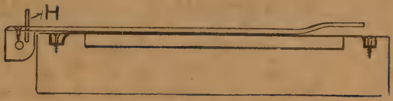


Fig 38.—Section of Platen, Showing Gripper

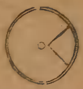


Fig. 36.—Opening in Top of Roller Mould

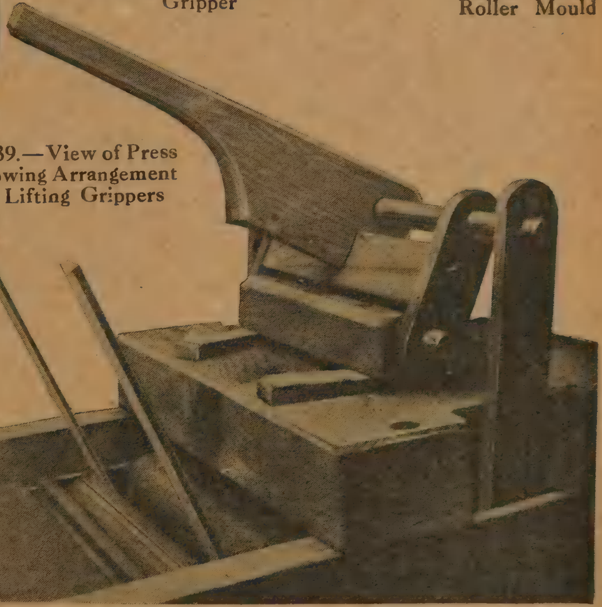


Fig 39.—View of Press Showing Arrangement for Lifting Grippers

The grippers are screwed at various points on the bar, according to the size of the job in hand. The correct position is easily found by taking a proof (of the set-up type) on the platen, and fixing the grippers just outside the impression.

Taxidermy: Setting-up Birds and Mammals

ALTHOUGH taxidermy embodies all the essence of true art it has never been recognised as other than a "back-street trade." Both artist and sculptor are often deeply indebted to it for motifs displayed on canvas or in marble, and yet the inspiration which guided the taxidermist's hand in the production of a fine subject is seldom recognised. The general public in visiting a museum seldom realise that they are looking upon the result of the labours of a true artist possessing a deep insight into anatomy and a true regard for Nature. The taxidermist, in giving a hardened, shapeless skin the perfect curves and the natural expression and carriage of a living body, meets with obstacles as difficult to surmount as those encountered in the hewing of shapeless marble into contour and form. True, the taxidermist's methods are more rapid than the sculptor's, and effect and finish are more easily attained, but the materials with which he works possess certain limitations not present in those of the sculptor.

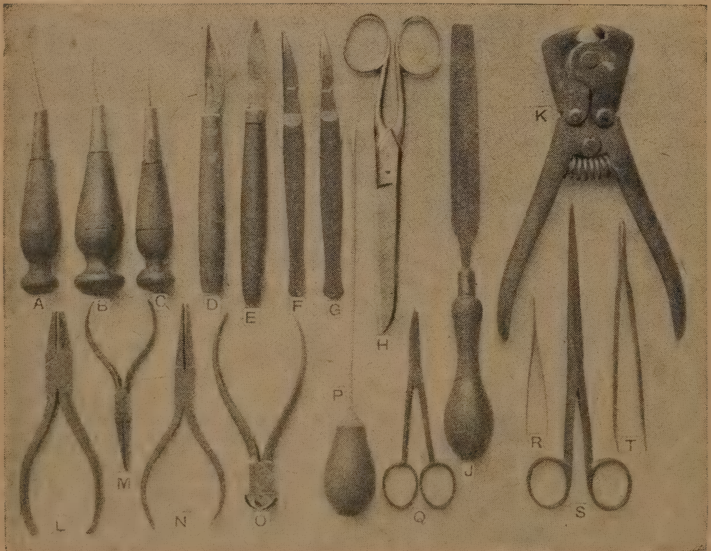


Fig. 1.—The Taxidermist's Tools: A, B, C, Awls; D and E, Skinning Knives; F and G, Scalpels; H, Shears; J, File; K, Top Cutters; L, M, N, Wire Pliers; O, Top Cutters; P, Stuffing Rod; Q, Dissecting Scissors; R and T, Tweezers; S, Tow Pliers

TOOLS

The fewer the tools used by the amateur taxidermist in the actual process of skinning and mounting both birds and mammals of small or moderate size the better will be his chances of acquiring dexterity in their use.

For skinning and mounting—or, to use

the trade term "setting-up"—the following list (see Fig. 1) embraces all that is really essential: A moderate-size skinning knife; a scalpel; a pair of large and medium size scissors, and a pair of fine manicure or dissecting scissors; two files of flat and triangular section; a pair of fine, medium, and large flat-nose pliers, with or without side cutters; a pair of small and large top cutters; a pair of tow pliers; a pair of straight-nose tweezers; stuffing rods; shave hook, awls and needles mounted in long handles; camel-hair mops, etc.

The ordinary skinning knives (D and E, Fig. 1) may be bootmakers' knives, procurable at any grindery stores. At a point where they are usually discarded by boot factors, the taxidermist will find them of useful and convenient size, and in this state they may be bought from boot repairers for a few pence each.

Scalpels (F and G) may with advantage have the high temper reduced before use, as the razor steel of which they are made is very liable to snap under the rather rough wear to which they are generally subjected.

The dissecting scissors (Q) should be of the finest quality procurable. They may be either curved or straight, and experience will show to what a variety of uses they may be turned; they are suitable alike for modelling purposes or for clipping off fine wires.

The pattern of wire pliers (L, M, and N) recommended is that without side cutters, as they generally have a better gripping power. The top cutters (K and O) will answer for all general wire-cutting purposes. The American variety with springs are convenient, but are seldom of good quality.

The tow pliers (S) are the only really useful tools used exclusively by taxidermists, and they may be procured at any naturalist's emporium.

Stuffing rods (P) may be made of charcoal-iron rod, one end being heated and flattened, a small triangular slot being cut out of the apex, whilst the other end is mounted in a suitable handle.

The shave hook is a plumber's tool, but it is used by the taxidermist for scraping skins. It consists of a triangular piece of steel, with the edges sharpened, fixed at right angles to a central rod. For use on mammal skins it may have one of the edges serrated in regular teeth by means of a file.

The awls (A, B, and C), shears (H), file (J), and tweezers (R and T) are also illustrated in Fig. 1.

MATERIALS

The ordinary and essential materials also are not numerous. They include the following: Tow, cotton, wadding, wood fibre, modelling-clay, hemp thread, fine twine, tin-tacks, wire nails, galvanised-iron wire of different gauges, copper or tinned iron "whipping wire," plaster-of-paris, hardwood sawdust, peat, sand, concentrated size, whiting, Seccotine, or fish glue, a set of artists' oil tube colours and brushes, varnish, turpentine, benzolene, pins and needles, various preservatives (mentioned in detail later), etc.

The above represent the ordinary requirements of the taxidermist for skinning, mounting, and casing up both birds and mammals.

Tow may be procured from any oilman's at about twopence per bundle, but if used in considerable quantity it should be obtained in the rough state from a ropemaker's.

The cotton wadding should be of the common whitey-brown quality, sold by drapers at about threepence per yard.

Wood fibre is less easy to procure in small quantity; it is used largely for packing fragile articles, and china and glass merchants generally have some for disposal. The finer it is the better. A quality almost silken to the touch, generally used for packing choice fruit, is most useful for fine work.

The modelling-clay chiefly used at the present day is the pipeclay or fireclay used by modellers and others. From clay-pipe makers it can be obtained in a plastic condition, suitable for immediate use; but otherwise it is bought at any oilman's in a dry state, requiring grinding down and working up with water.

Hemp thread is similar to that used by bootmakers in making wax-ends, and may be bought at grindery stores at about fourpence or fivepence per ball.

Galvanised iron wire should always be used in preference to any other kind, as the various preservatives—alum especially—are so liable to collect atmospheric moisture, which would ultimately cause unprotected metal to rust.

Hardwood sawdust may be obtained from any sawmills; for use as a cleaning agent (to be described later) it should be passed through a fine sieve, the coarser material being rejected.

Peat is one of the most important materials employed in making up artificial rockwork, etc. This natural product occurs in various parts of Lancashire, North Wales, etc., a regular industry being the cutting of it for supply as a substitute for coal. With the hard, dense material usually supplied for such use, however, the taxidermist has nothing to do, for it is the soft, spongy upper deposit which alone is suitable for his purpose; and this is generally rejected in the ordinary way, or sold to horticulturists in a shredded condition for lightening heavy soil. Unless one is able to select suitable material actually on the peat beds, it is cheaper to buy from the trade naturalist, who usually supplies selected pieces of convenient size for about 10s. per hundred.

The sand used for fitting-up purposes may be silver sand, to be bought at oilshops.

For large expanses of ground or rockwork, common paint, as sold in tins, may be employed; but tube oil colours will be found to be far more convenient and satisfactory in use for smaller subjects. These may be of second or "students'" quality, as packed by artists' colourmen, in tubes at twopence each. The colours used by the taxidermist in the ordinary way embrace: Zinc or flake white (these are generally put up in double tubes at a little more than the price of the single size), black, burnt sienna, raw sienna, burnt umber, raw umber, pale and dark chrome yellow, pale and dark chrome green, prussian blue, vermilion, and rose madder. Pale megilp will also be needed; it is a medium useful for a variety of purposes in the finer work.

The varnish employed for all ordinary purposes may be of medium quality, pale oak, or another of similar type; when worked down with an equal quantity of turps it forms a medium for tube colours suitable for most purposes.

Benzolene, which is used in conjunction with plaster-of-paris or sawdust for cleaning fur or feather, may be of the ordinary quality sold at oilshops; or motor petrol may be employed instead, and gives even better results. Extreme care must be taken in the use of both, as they are highly inflammable.

For all ordinary sewing purposes needles of the usual type may be used, but glove needles with curved ends are necessary in the mounting of larger mammals.

Preservatives.—The effect of curing, say, a mammal skin is that of disintegrating connective tissue to a certain extent, discharging blood, mucus, and natural moisture, and contracting the superficial epidermis. Thus, after a skin has been properly treated, the hair or feathers are not liable to drop out, putrefaction is arrested, and the internal surface hardens rapidly. Many amateurs have an idea that if curing is effected by means of some poisonous agent—arsenic, for instance—the specimen is immune from the attack of moths and mites. This, however, is an erroneous notion, for protection of the fur or feathers is a distinct and separate process altogether.

The usual curing agent for mammal skins of large size is a bath composed of 1 lb. of alum and $\frac{1}{4}$ lb. of salt to 1 gal. of tepid water. In this the hide may be immersed for a few days, until it has become thoroughly impregnated with the active agents. For skins of moderate or small size, saltpetre may be substituted for the common salt. The alum is mixed in equal quantity, the mixture is slacked with water to the consistency of cream, and applied with a camel-hair mop. Pure arsenic (in powder) is to be recommended for small skins.

The best preservative for bird skins is arsenical soap. The use of arsenic ensures perfect preservation of specimens under any conditions; but the same cannot be said of preservative soaps in which the drying agent may be lime or another dehydrant other than alum. Arsenic is a dangerous chemical to handle incautiously, and the constitution is impaired by the inhalation of the dry powder or by allowing the chemical, in whatever form it is used, to gain access to the blood through open sores, or to remain behind the nails. Yet, with care, any such chances of danger may be easily obviated.

The formula for arsenical soap is as follows: Boil together over a slow fire 1 lb. of soft soap with 1 lb. of powdered whiting, with a sufficiency of water to form a stiff cream. When thoroughly amalgamated, add 6 oz. of salt of tartar. Remove the preparation from the fire, and stir in 1 lb. of dry arsenic; on cooling, add 2 dr. of eucalyptus oil. The preparation should be kept in well-stoppered bottles, and is intended to be applied with a brush.

The non-poisonous soap, as recommended by Montagu Browne, is similar in composition to the above, but the salt of tartar and arsenic are omitted, their place being taken by a small quantity of chloride of lime—2 dr. to each pound of the soap and whiting compound. In dry weather the preparation answers very well, but when there is much moisture in the atmosphere, skins cured by it will not dry, and are liable to become mouldy and rotten.

Another necessary preparation is the mercury wash for protecting uncased specimens, such as animal heads intended for wall display, against moths and mites. This is prepared by adding a small quantity of perchloride of mercury (corrosive sublimate) to common methylated spirit, roughly to the extent of 5 per cent. The mercury will readily dissolve in the spirit, and the solution should be tested before use in the following manner: Dip a black feather into the spirit and allow it to dry. Should a white sediment appear on the surface, an excess of mercury is indicated, and further spirit should be added until none of the white deposit remains on drying. The preparation is a deadly poison, and should be applied with a camel-hair mop.

Albo carbon, or naphthalene, affords the best possible means of protecting cabinet or cased specimens from the ravages of insects. It may be obtained in a shaly powdered condition, in lumps, or candle form. The powder is useful for dusting amongst loose skins kept in boxes or drawers, and the lump is suitable for inclusion in cases. Camphor, red pepper, colocynth, and various other less unpleasantly scented agents have been recommended for a similar use; but none of them is so thoroughly reliable as naphthalene. It should be remembered, however, that whereas the chemical is an excellent preventive for moths, mites, etc., it will not destroy them when once they have gained a footing.

THE METHOD OF SKINNING BIRDS

Cleaning Plumage.—Before any attempt is made to skin the specimen it should be thoroughly cleaned, if at all bloodstained or otherwise dirty. This can be performed in the following manner: First sponge the soiled areas with warm water to which has been added a fair quantity of salt, using pads of cotton-wool for the purpose, and rubbing in the direction of the downward trend of the feather tracts. The salt will cause the congealed blood to flow freely again, and the wool pads should be discarded as soon as they become thoroughly soiled. When by this means the plumage has been rendered perfectly clean, it should be saturated with benzolene or petrol, and fine sifted sawdust rubbed on until the spirit has been entirely absorbed. Plaster-of-paris may be used instead of sawdust in the case of birds with very light or white plumage. The final operation consists in removing the dust or plaster by beating with a small stick or blowing with bellows, and this should be performed thoroughly, or the drying material will continue to work out of the feathers for long after the specimen has been mounted.

The Skinning.—All necessary tools and materials having been placed within convenient reach, the skinning of the bird specimen may be proceeded with. There are several places where the opening cut may be made—the stomach, the breast, the back, and under either wing; but putting aside the back opening as suitable only in the case of diving birds with white breasts, the side or under-wing cut is not only the most convenient and the most cleanly, but obviates the chance of cutting into the entrails. Moreover, should the specimen be at all slightly decomposed, it is almost impossible to make the opening cut on the stomach without loosening many feathers. The beginner cannot do better, then, than adopt the side cut.

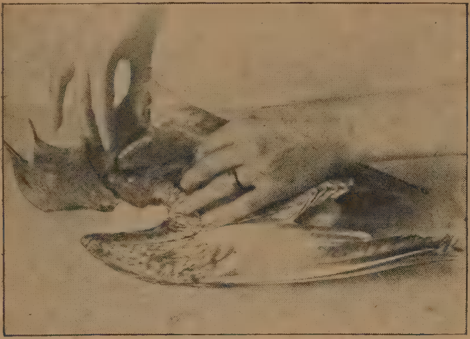


Fig. 2.—The Opening Cut in Skinning a Bird

The specimen being laid on the table, with the less damaged side downwards, a clean, straight incision is made with the scalpel from a point a little in advance of the insertion of the wing into the body at the base of the humerus to another position above the thigh (see Fig. 2). The skin should then be separated, by means of the scalpel and finger-tips, as far as possible from the body. The base of the wing (the humerus) will thus be exposed, and, by means of the scalpel blade, should be separated from the body. At this point a certain amount of blood may begin to flow, and a small quantity of plaster-of-paris should be applied in order to stanch it. Now by further loosening the skin from the shoulder and breast, the neck will appear, and while this is held by the finger and thumb of the left hand, the vertebræ may be cut through between the shoulders by means of the scissors or shears wielded by the right hand (see Fig. 3). More plaster having been applied to the body and skin, the latter should be turned inside out and protected from soiling by the palm of the left hand, the fingers of the same being used to draw the skin off the body towards the other wing. When this has been fully exposed, the scissors or scalpel may be slipped under to separate it from the body (see Fig. 4).

A hold may now be obtained with the finger and thumb of the right hand on the upper part of the body, while the left hand may be employed to work off the skin towards the legs. It will be noticed that the palm of the left hand still covers the skin removed. When the tops of the legs begin to appear, a fresh hold may be taken by the right hand on the off thigh, and while the fingers of the left hand still retain a hold on the skin, the leg may be drawn out. The scissors again come into play in dividing the limb at the knee (Fig. 5).

The near leg having been treated in a similar manner, skinning may be continued towards the tail. In many birds, especially pigeons, game birds, etc., the skin of the back is very tender at this point, and unless extreme care is exercised in separating it, a nasty gash may result. When the extreme end of the body has been reached, the scissors may be

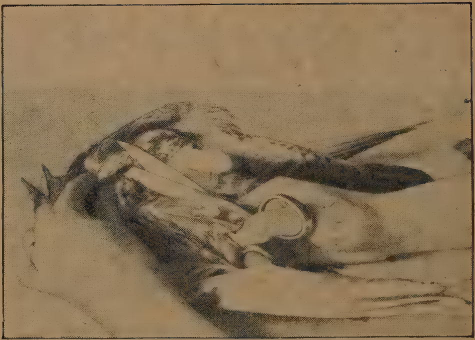


Fig. 3.—Severing the Neck Vertebræ

used to cut through the bones occurring behind the pygostyle, in which the tail feathers are inserted, and also the vent in the same operation, thus completely freeing the body from the skin.

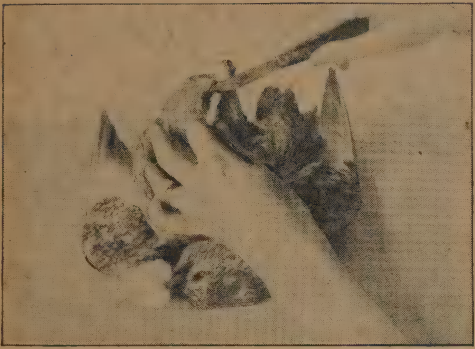


Fig. 4.—Dislocating the Off Wing

The process known as "trimming-up" now begins. The two oil glands situated above the base of the tail should be carefully removed, and as much flesh cleared away from the bone as possible, extreme care being exercised to prevent cutting into the bases of the tail feathers. The flesh from each leg bone may then be removed by severing the sinews and drawing it up to the top of the joint in one piece, finally cleaning it by cutting through the extreme top of the bone with the scissors. The bone should then be wrapped lightly with tow, and after the skin has been thoroughly anointed with arsenical soap or whatever cure may be employed, returned into place. Curing may also be performed on the lower portion of the body skin.

The wings now require attention. With the finger and thumb of the right hand, a hold may be obtained on the lower joint of each, and while the fingers of the left hand are employed in forcing back the skin, the whole of the first and part of the second joint will be exposed. The flesh may then be removed, and, as in the case of the legs, substituted by tow, curing of the skin performed, and the limb returned into place. In the case of large birds, a satisfactory removal of the flesh from the second joint, formed of the two bones the radius and ulna, can only be performed by making an incision along the under-surface of the wing, this opening being drawn together subsequently by a few stitches.

Now, by turning the skin inside out and gently pulling the neck, the base of the skull will appear. The finger-nails and blunt end of the scalpel should be used to separate the skin from the bone. On each side of the head, however, two obstacles will be encountered. These are the ear sacs, which should be pulled out and not cut through. The eyes will then appear, and the scalpel should be employed with care in separating the eyelids from the skull. The actual cutting should be performed far behind the apparent junction of the lids with the orbit, or a nasty gash will be made on the side of the head. An unfortunate error of this kind will show how deceptive the apparent position of the skin really is. After the eyes have been passed, the skin should be loosened right down to the base of the beak. The skull may then be cleared of flesh. The eyes are first removed by a "gouging" process with the scalpel handle, then the tongue, roof of the mouth, and neck in one cutting with the dissecting scissors. Next the flesh at the base and sides of the skull, and finally the brains. To clear these successfully, the foramen at the base of the skull should be enlarged by the removal of a triangular piece of bone

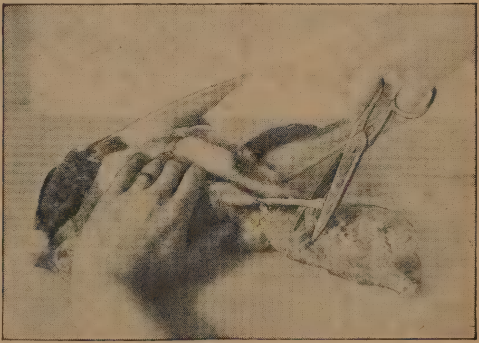


Fig. 5.—Severing the Off Leg

to admit the scalpel blade or "brain spoon," final cleaning being performed with pads of cotton-wool twisted on the end of a stuffing rod.

The skin and bone having received a thorough dressing with the cure, the interior of the skull should be tightly filled with finely cut tow, cotton-wool placed in the orbits, and the head returned into place. Most beginners experience some difficulty in performing this latter operation successfully. By pressing with the two thumbs on the base of the skull, and using the finger-nails to draw the skin forward, the beak will soon make its reappearance, and the final turning may be performed by gently drawing it out. The cleaning up of the skull should be carried out as rapidly as possible, for the skin of the head and neck dries very quickly.

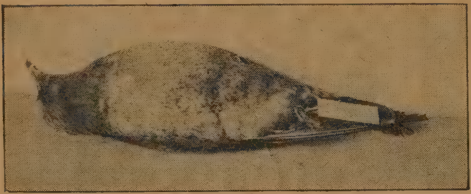


Fig. 6.—The Finished Bird Skin

When all superfluous fat, tissue, etc., have been scraped away from the body skin (this operation being a somewhat lengthy one in the case of sea birds), the two lower wing bones should be connected by a piece of coarse thread the same distance they are apart in life, and a final curing performed.

"Making-up."—The skin is now ready for "making-up." A suitable piece of stick should be pointed at one end, and lightly wrapped with tow to form a false neck. The pointed end is then inserted in the base of the skull, and the rest of the stick laid in contact with the back within the body skin. The general interior is then loosely packed with tow, or in the case of small birds with cotton-wool. The opening cut may then be drawn together with a few wide stitches, and the whole skin worked into proper form. Fig. 6 shows the correct shape approved by all the large museums and principal collectors. The neck is considerably shortened, the breast is raised, and the upper plane of the body sloped gently down to the tail. The legs are crossed in a symmetrical manner and tied, the label being attached to them. The wings are brought closely into the sides, and secured with thread passing through the body backwards and forwards once, the two ends being tied and hidden amongst the small coverts. The feathers generally are brought into place by being worked at their bases by a needle. The beak is tied together by a thread passing through the nostrils, and, by bending the head well back, is laid almost in a straight line with the tail. Finally, the cotton-wool is drawn slightly out of the orbits in order to separate the eyelids, and the skin may then be put away to dry in a cylinder of stiff paper.

In "making-up" the skin a departure from the general rule will be necessary in certain instances. Long legs may be doubled up and laid on each side of the body. In the case of herons, etc., the neck may be bent down to the side or over the back, wire taking the place of the stick in the false neck, and so on.

Modified Methods of Skinning.—In certain instances modifications of these methods are necessary. As already mentioned, diving birds, such as grebes, guillemots, etc., should be opened down the back. In this instance the wings on each side are separated in turn, then the legs and tail, so that there is no necessity to cut through the neck until the skull is reached. Certain birds with long necks, such as herons, ducks, and geese, require to have the skin at the back of the head split before the skull can be withdrawn. In the case of owls, the beginner had better remove the eyes through the mouth, the actual face being left undisturbed, as it is difficult after skinning down to the beak to restore the natural expression. With birds having legs feathered down to the toes, the skin should be separated to permit of curing. The scientific determination of sex in birds the male and female of which are similar in plumage, such as the hedge sparrow, robin, seagulls, etc., and the young of many species, is a process which should, if possible, always be carried out on the body after removal of the skin. This consists in cutting through the ribs on the side, and after moving aside the viscera, viewing certain of the generative organs, which lie and are attached to the back, a little below the lungs. In the case of a male bird, the testes will appear as paired white egg-shaped organs lying on each side of the backbone; whereas with the female the ovaries consist of numerous globular bodies of varying size—the undeveloped eggs. In winter time, and in the case of young birds, both male and female organs are of small size, and to find them requires careful searching.

MOUNTING BIRDS

Hard-body and Soft-body Methods.—As in skinning, there are several methods of mounting or "setting-up." Nearly every taxidermist has his own particular modification of one or the other of the two chief methods, namely, the "hard" and "soft" body. Other processes, such as the elaborate making of a manikin body by exact methods, mounting on the skeleton, etc., have from time to time been advocated, but these are impracticable to the ordinary worker with half a dozen or more birds to handle in a limited space of time. Choice may therefore be made between the "hard-body" and "soft-body" methods. The latter has fallen almost completely into disuse amongst rapid workers, necessitating as it does the intricate building up of an internal framework of wire supports, and the packing in bit by bit of the stuffing material. The time occupied in the mounting of a bird by the "soft-body" process would suffice for the setting-up of three by the "hard-body." Much beautiful work has been done by taxidermists who used the "soft" method and no other; but, as it is far more difficult by its use to attain any degree of proficiency, it cannot be recommended to the beginner. Therefore the "hard-body" process will be described in detail. As it will be necessary to refer to certain bones by their scientific names, a bird's skeleton, with the bones separately labelled, is shown by Fig. 7.

Starting the Mounting.—Most taxidermists prefer to mount a bird whilst it is still in the "green" or fresh condition. It is therefore supposed that the subject has been brought to the point where, in the making-up of a birdskin, the filling is about to be inserted. When a skin is intended for immediate mounting, however, greater care should be taken with the modelling up of the limbs and skull. With the former the beginner had better restore the flesh removed from the one leg or wing before the other in each case has been trimmed, so that a copy for reference is obtained. In modelling up the tibio tarsus, or leg joint, and the humerus, or lower wing, cobbler's hemp should be used to secure the tow in place after binding. In the case of birds of large or medium size, the head may receive a thin layer of moist modelling-clay over the cotton-wool placed in the orbits, at the base of the skull, and other positions from whence small quantities of flesh have been removed. The skin is then ready to receive the false body.

The False Body.—Select a wire of suitable thickness, and in length about one-third again as long as the original body and neck. The lighter the wire the better, in consistency with sufficient strength. No definite rule may be laid down, but experience will soon dictate in this matter. The two ends should be sharpened with a file to a triangular point, and on one-half of the wire the false neck should be formed by twisting on successive strands of tow, until a sufficient thickness is obtained, when hemp may be used to bind the whole into position. A quantity of wood fibre is then compressed between the hands until a rough semblance of the original body is formed. The lower end of the wire is then inserted into this mass at the part intended for the upper end of the body, and passed directly through. Thus the lower end of the neck is brought into direct contact with that portion of the false body intended to form the shoulders.

Next, by continuous binding up and down, much in the same way as a bobbin is wound, the wood fibre is moulded into shape. Compression here and there with the finger and thumb is necessary during the binding to obviate unnatural lumps, and additional bunches may be required on the breast and thighs in order to produce a manikin body as nearly like the original as possible. In the case of large birds, false thighs to supplement the femora should be made separately and bound to the body. The binding thread should finally be given a dozen turns round the lower end of the body wire, and this latter is then bent sharply round in a semicircle to pierce the body, and locked by being drawn out with pliers. The free end may then be cut off flush with the surface of the model. The usual form of such a false body is shown in Fig. 8, further particulars of which are given later.

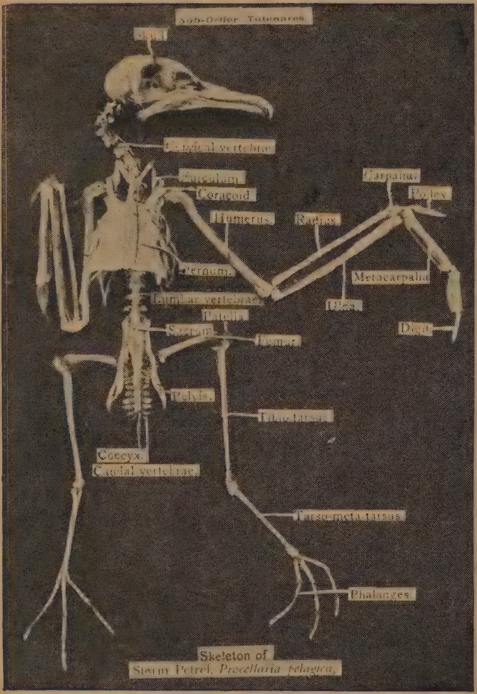


Fig. 7.—Skeleton of Bird, with Principal Bones Labelled

Before an attempt is made to insert the body into the skin, the beginner should pass a pointed wire diametrically through the back, so that the point emerges directly in the centre of the breast. The point, however, need not project, but lie just under the surface, so that the finger, in slightly compressing the body, may feel it.

In passing the head wire up the neck, the point may be protected by a small pad of cotton-wool, which may be removed by touch from the outside when the base of the skull is reached. The point is then inserted through the foramen and passed out through the top of the cranium between the eyes. This operation, difficult somewhat to the beginner, may be successfully carried out by a twisting movement to and fro of the body, held in the right hand, whilst the head is supported between the finger and thumb of the left hand. When the wire makes its appearance through the top of the head, it may be gripped by the pliers and drawn out until the false neck comes into direct contact with the base of the skull.

Inserting False Body into Skin.—The next operation consists in working the skin over the artificial body. This should be performed gently; by drawing the shoulders well down and slightly bending the neck downwards, the hind part of the body may be passed into the skin without undue force. Now, having ascertained that the body is in its correct position, point a wire, and pass it through the base of the tail and into the body. The free end should be bent roughly into T-form, the two arms forming a flat support for the tail feathers. The next step is perhaps the most difficult for the beginner, namely, the insertion of the leg wires. These should be somewhat stouter than the body wire, and of ample length. One end of each should be sharpened to a triangular point, and inserted towards the inside of the leg at the heel. By a twisting movement the wire may be worked up the scaly portion of the leg as far as the first joint, namely, to the top of the tarso-meta-tarsus (see Fig. 7), where it may show a tendency to protrude. There is, however, a channel between two processes in the bone, through which the wire may be passed without much trouble. The operation may be materially simplified by slightly bending the bone inwards without actually dislocating the joint. Once this point has been passed, the second joint (the tibio-tarsus) offers little or no obstruction, and the wire may be worked up to the top as close to the bone itself as possible, then through the body, to which the emerging end may be firmly bolted by being bent into a hook, the point of which is drawn back again into the body.

In passing the wire through the false body, it is necessary to remember the presence, within the body skin of the living bird, of the third main joint (the femur), and ample allowance should be made for its relative position in selecting the spot for the insertion of the point of the leg wire. In Fig. 8, A shows the proper position, and also the method of bolting the leg wire. Sufficient stress cannot be laid on the necessity for attention to this detail, as much work is spoilt by the impossible position of the legs. Note the balance given to the specimen figured in Fig. 9. This is only gained by thrusting the legs as far forward as possible before the insertion of the points of the leg wires.

Temporary Support.—Now that the specimen has some means of support, it may be fixed to a temporary stand. For birds on the ground, a slab of peat will be found most convenient. The wires may be pushed through at the desired positions, and the free ends bolted by being twisted into L-shape, the point being returned into the peat (see B in Fig. 8). A hoop of thick wire, the two ends of which are fixed into a slab of peat, forms a rapidly constructed perch for specimens finally intended for display on twigs. Such a stand possesses the additional advantage of being easily bent into any required shape or position. The leg wires are attached to this latter type of mount by being simply twisted on. Birds to be set up in full flight need not be attached in any way until the wings have been wired.

Obtaining Position and Form.—The specimen may now be brought roughly into position and form. As previously mentioned, the desired pose should be decided on and carried out. Such matters as correct attitude, form, and expression may be learnt solely by reference to living specimens. One particular, however, may be described, namely, the bend of the neck into a more or less acute curve, a little in advance of the breast. In the finished specimen, attention to this detail will account for the elegant double curve seen between the neck proper and the body.

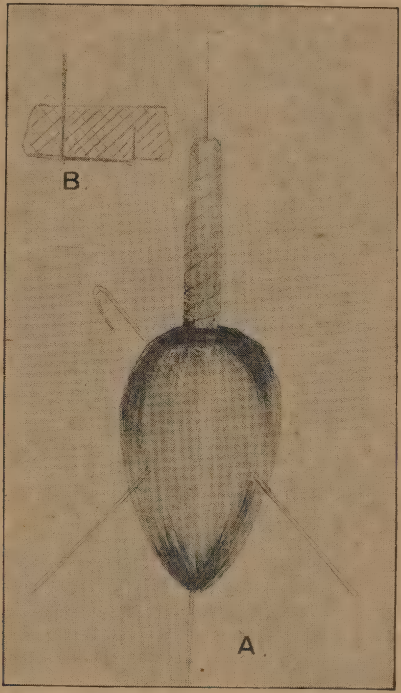


Fig. 8.—False Body, Showing Position of Leg Wires

Wiring the Wings.—The wiring of the wings may now be proceeded with. When a specimen is to be set up with these members partly extended, or in full flight, two wires of fair length will be necessary for each wing (see Fig. 10). They may be considerably lighter than the leg wires. One wire is inserted into the extreme tip of the final wing joint, or rather series of joints, labelled on the skeleton as metacarpalia (see Fig. 7), on the under-side and passed from thence down the two succeeding joints (radius and ulna and humerus), as close to the bones themselves as possible, and from the lower end of the latter through the body, to be bolted in a manner similar to that adopted with the leg wires. The wire from the off wing will emerge in full view between the opening cut. The other, however, requires bolting by sense of touch within the skin on the off side. This is not difficult to perform with long-nose pliers.

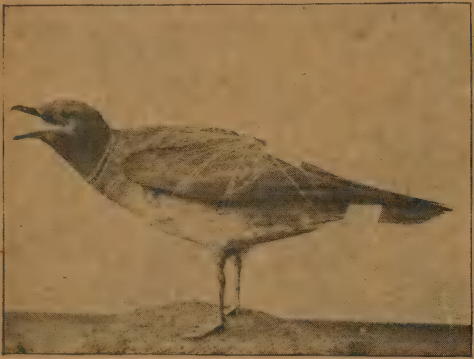


Fig. 9.—Bird with Closed Wings, Showing Method of Binding

The correct position for the insertion of the point of the wire into the body in each instance is shown in Fig. 10; also the track of this wire through the wing itself, and that of the second wire, which, however, simply pierces the first primary feather and enters the body for a short distance. This second wire is intended for spreading the feathers, and also to give a gentle curve to the entire wing.

For specimens with closed wings a more simple method may be adopted. Two short wires (pins in the case of small birds) are used for each side. After the wing has been settled in place, one wire is passed through the joint between the humerus and radius and ulna, and into the body; the other wire is inserted straight through the first primary feather. The specimen shown in Fig. 9 has been treated in this way, although the wings are slightly raised. When the tail requires spreading a fine wire should be passed transversely through all the feathers a little distance above their bases. This operation requires patience and care in the correct placing of each individual feather. With very small specimens a fine entomological pin should be used instead of a wire.

The opening cut may now be drawn together, either by a few wide stitches, or pins passed through the skin and into the body.

Modelling-up and "Feathering."—The next operation consists in final modelling-up and "feathering." By the use of a mounted needle working at their bases, the feathers are brought into place. This should not be a difficult matter if the false body is of the proper shape and size, but if it be a "misfit" any amount of "feathering" will not conceal the fact. Also a well-made body materially assists the operator in the oft-times necessary task of making a few feathers go a long way to hide some damage. The head should receive careful attention. The cotton-wool within the orbits may be worked with a needle between the eyelids to give the specimen a natural expression before the artificial eye is inserted. This latter

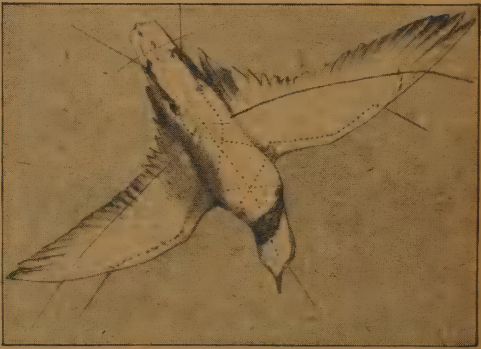


Fig. 10.—Bird in Full Flight, Showing Method of Wiring

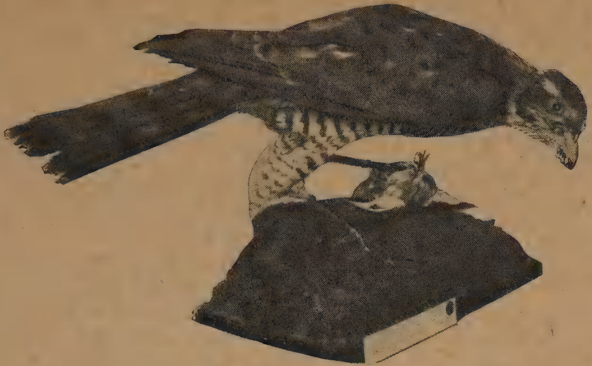


Fig. 11.—Sparrow-hawk Feeding

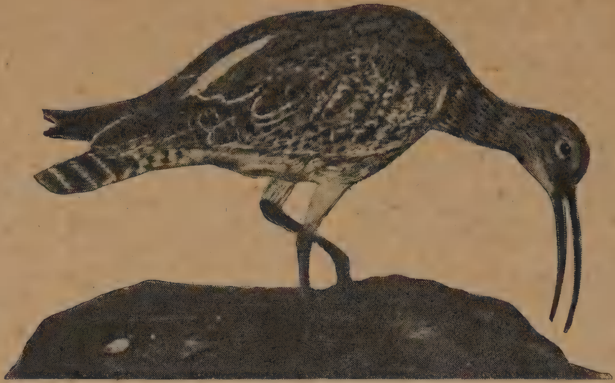


Fig. 12.—Curlew Feeding

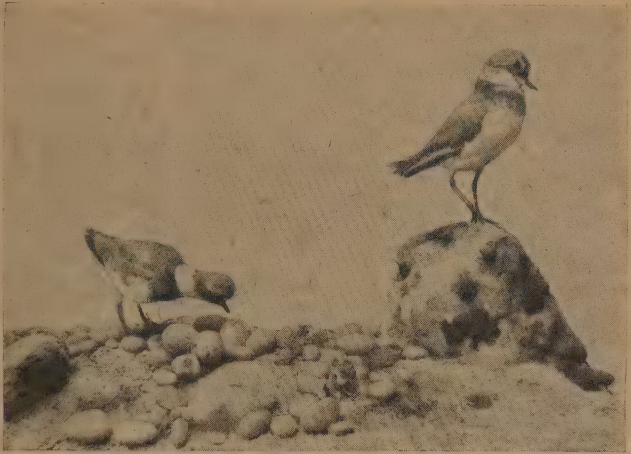


Fig. 13.—Ring Plovers in Nesting Site, Closely Imitating Natural Surroundings

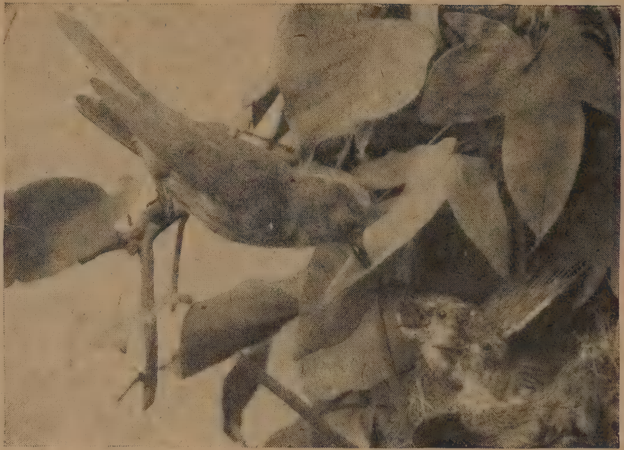


Fig. 14.—Part of a Nesting Site of Spotted Flycatchers, Showing Use of Dead Ivy-leaves Tinted with Colour

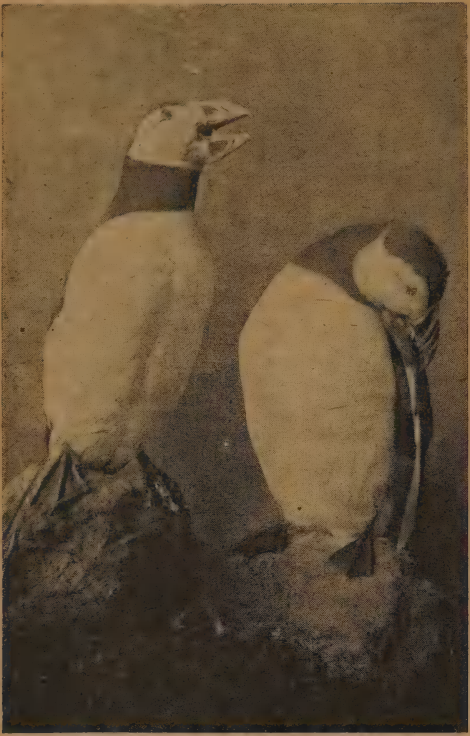


Fig. 15.—Puffins, in Nesting Site

operation requires considerable patience from the beginner. The eyelids require catching up with a needle and drawing over the edges of the eye. Much depends, moreover, on the final position of the lids. Any sort of an expression may be achieved by the handling of these, and it is a mistake, perpetrated far too often, to work them into a complete circle.

Binding Mounted Specimen.—The final stage consists in binding the mounted specimen in order to prevent the feathers rising during drying. This is performed by means of cobbler's hemp passed from point to point, and twisted over wires inserted at necessary points. No arbitrary rule may be laid down with regard to this matter. Some specimens require more binding than others, but a general idea of the usual arrangement may be seen in the specimen figured. The English, German, or American methods of performing this simple operation will not be discussed, but it may be emphasised that a specimen cannot be bound into good shape if it does not already possess it, and, further, that the thread should be passed as lightly as possible over the feathers when they have once been brought into place. "Stays" should also be used on the wings if outspread, and always on the tail. These consist simply of strips of stiff paper, held in position on each side of the feathers by means of a few pins passing through both, the points being inserted into small pieces of cork. Birds in full flight may be temporarily suspended by means of a wire passing through the body under the wing, the free end being thrust into a slab of peat, or secured to the cork of a bottle half-filled with sand.

In hot weather the mouth, nostrils, and naked parts may with advantage be washed over with a little concentrated

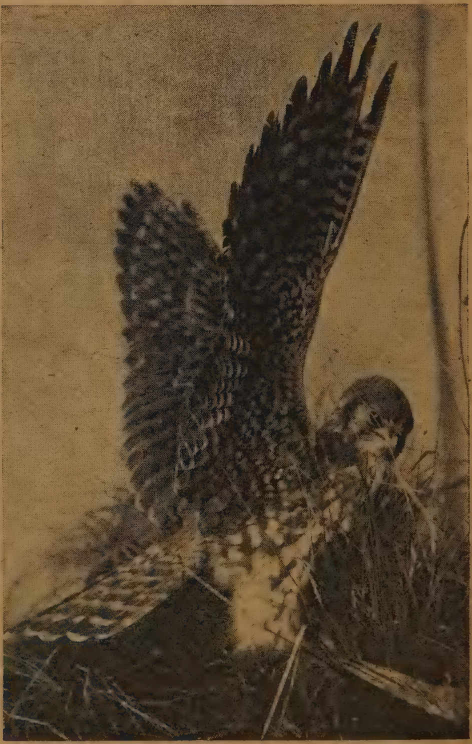


Fig. 16.—Merlin Hawk

formalin, and in any circumstance the specimen should be put away in a cool place to dry for at least three weeks before final treatment. This consists in cutting off the wires flush with the body, and concealing their ends amongst the feathers, removing the binding threads, and restoring the naked parts, interior of beak, etc., in an open-mouthed specimen. Some beautiful specimens of the taxidermist's art are illustrated by Figs. 11 to 17. The representation of natural surroundings and the making and fitting up of cases will be dealt with in a later chapter.

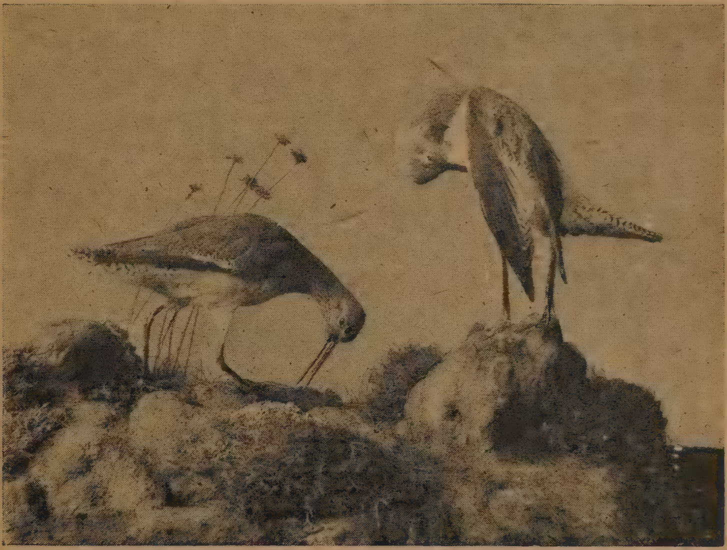


Fig. 17.—Pair of Red Shanks

MOUNTING BIRD-SKINS

The beginner who aims at acquiring a complete collection of those species which at some time or another have been known to occur in Britain cannot expect, however advantageously he may be placed, to obtain all his specimens "in the flesh." It may not be considered essential, moreover, that the rarest of the migrants or occasional visitors be trapped, shot, or snared on British soil, when for a few shillings such species (Continental specimens) may be obtained from the dealers in " skin " form.

In buying skins from the dealers the best only should be selected. Their form should be taken note of; it is often a criterion of the quality of the making and curing. Fig. 18 shows three specimens of correct shape, the centre one being enclosed in a cone of paper, in which a newly made skin is put away to dry. The smell may also assist in detecting specimens which may be mouldy within, and liable to fall to pieces when damped preparatory to mounting. A strong smell of camphor, moreover, sometimes indicates that this chemical has been used solely for curing purposes, which is worse than useless, as it appears entirely to destroy elasticity and coherence. It may, however, have been used simply as a moth preventive, in which case it may be presumed that the skin was made before the general employment of naphthalene, which is more effective and cheaper, and it should be rejected on suspicion, for the older a skin is, the less easy is it to damp and soften. The worst type of all, perhaps, is that in which curing has been performed solely with dry earth, hardening being hastened very often by a slow oven. Such skins, in the case of exotic species—for example, birds of Paradise, tanagers, etc.—are generally of native preparation; but the writer has known of Continental bird-skins which appeared to have been treated in a similar manner; such specimens cannot be successfully handled by the ordinary amateur.

Damping Box.—If a number of such skins are to be mounted, a " damping box " will be found to be a most useful adjunct to the taxidermist's outfit. This consists of a stout wooden box, strongly nailed or screwed together, the sides and bottom of which are lined with plaster-of-paris about 1 in. thick. The plaster, being porous and hydroscopic, retains moisture for a considerable length of time, and when filled with water and subsequently emptied, has the capability of damping specimens placed in contact with it without actually wetting them. Such a box may be easily converted from an ordinary strong box by fixing inside the box a temporary partition, well oiled, the requisite distance from each of its walls in turn, and filling the intermediate space with slaked plaster, the partition being removed when the plaster sets. The bottom layer need only be poured in and allowed to set evenly.

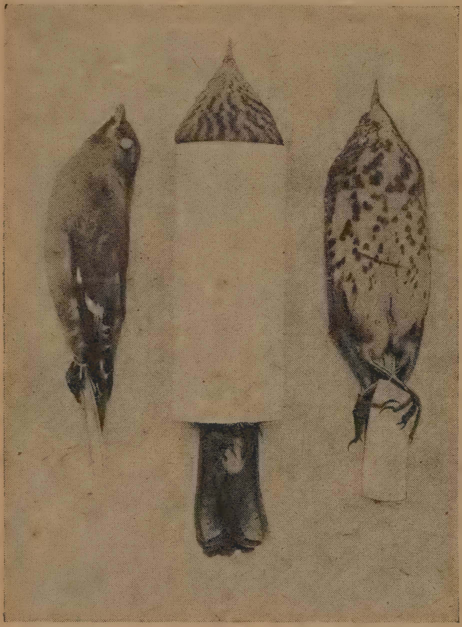


Fig. 18.—Bird "Skins" of Correct Form

Damping a Skin.—The skin to be mounted is placed in the box for twenty-four hours, when it should be possible to cut the stitches on the side or belly, remove the stuffing material, and, by means of the scalpel, loosen the skin from around the skull. The interior of the specimen should then be filled with pads of tow, moistened with warm water, to which may be added a very small quantity of carbolic acid. With the tow pliers a strand of this damping material may be placed right up the neck. The eyelids should be plugged with moist pads of cotton-wool, and the feet wrapped closely with the same material. The specimen should then be returned to the box, and allowed to remain for another twenty-four hours or so, when it will be in a soft enough condition to mount.

Mounting.—Presuming that the specimen is sound (and the majority will be found to be so), the interior should first receive a careful scraping with the scalpel to remove any superfluous fat or tissue, and to further soften the skin itself. The skull should be entirely loosened from the skin by means of the needle, working through the eyelids. The wings should then be rendered supple by being worked between the finger and thumb of both hands, especially at the articulation of each joint, so that the feathers hold correct relative position to each other when the wings are fully extended.

After this preliminary treatment, the feathers generally present a decidedly bedraggled appearance, and it is necessary to put the specimen through the cleaning process in order to restore their pristine beauty.

In mounting the specimen, the skin need not be turned inside out in order to remodel the head. This may be done entirely by means of the tweezers passing through the eyelids, and tow pliers working up the neck or through the mouth. It will be necessary, however, to withdraw the leg- and lower wing-bones from the skin and restore the binding tow which will have become saturated during the process of damping.

In other respects the mounting of a dried skin differs but slightly from that of a fresh one. The passing of the leg wires up the scaly portions of the limbs may sometimes prove troublesome, and it may be necessary to work a jeweller's "broach drill" through before inserting the wire.

Should the legs, however, threaten to upset the correct poise of a specimen, as they not infrequently do in the case of birds mounted from skins, they should be carefully separated entirely from the body, and, having been wired, fixed in a natural position sufficiently far forward. Wings also may be treated in a similar way; but such methods should not be resorted to until more gentle means have failed.

Treatment of Damaged Skins.—On removing the damping material, the type of specimen will be seen at once. If it be one in which curing has been imperfectly carried out, a plentiful harvest of loose feathers, or a hole or two in the skin itself, may be the result. The apparent damage is generally greater than it really is, and the beginner who intends to work on dried skins must be prepared for such rough surprises, and learn to correctly estimate the difficulty before deciding that the specimen is not worth the trouble of mounting. Of course, where really valuable specimens are concerned or those of special interest, the process of rehabilitating, feather by feather almost, is long and tedious; but it is nevertheless possible to perform. The specimen shown by Fig. 19 was mounted from no less than twenty-seven separate pieces and innumerable odd feathers. There are rarities in the national collections of this country and America which have been successfully restored after being reduced to little more than a mass of moth-eaten feathers.

When a specimen has literally dropped to pieces during damping, and it is of sufficient value to take some trouble with, is should be treated as follows: An artificial body and neck are first made up as nearly as possible to the correct shape. The legs are then taken, wired and attached, the free ends being fixed in the required position to the perch or ground stand. The manikin is then bent as far as possible into the desired position. The head and tail may be attached, the former in the ordinary way by means of the projecting neck wire, and the tail by two short wires inserted through the base in order to prevent its twisting. The wings are then added, secured to the body with two or three pins. Finally, bit by bit, the body feathers, with the patches of skin attached, are placed in position and secured with pins driven into the body, working, as far as possible, up from the tail.

Towards the end of the process, the specimen will have assumed something of the nature of a novel pincushion; but this appearance will soon disappear under the wire cutters, by means of which the projecting ends may be reduced to a level with the body. Before this is done, however, it is necessary to see that all the feather tracts are nicely in order. Then follows the rather slow operation of replacing loose feathers. These should be taken one by one within the tweezers, slightly touched with paste at the shaft, and laid carefully in place. It is surprising what an hour's work of this description will do to improve the appearance of some "moulting" specimens. In the case of badly damaged subjects it is permissible to supply the lacking plumage from another specimen.

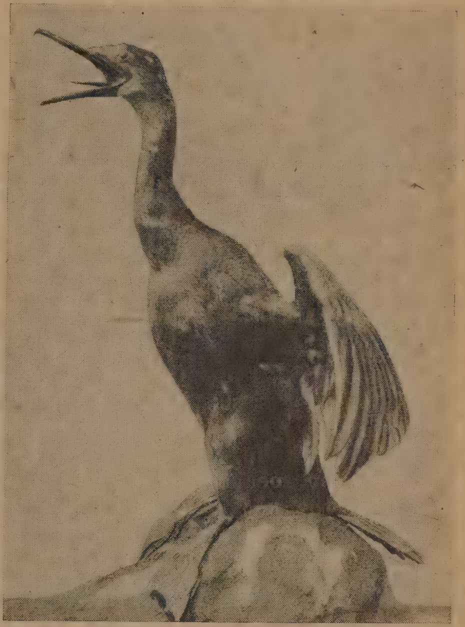


Fig. 19 —Common Shag Mounted from "Skin"

SETTING-UP MAMMALS

There is more risk in skinning mammals than birds, since feathers hide far more in the way of damage to the skin itself than will fur or hair, unless it be fairly long. The majority of mammals that come into the hands of the amateur taxidermist are "short-coated," and in consequence an ugly gash in the skin, however carefully repaired, will tend to detract from the good appearance of the mounted speciman when finished.

The skinning of mammals may be divided into two very dissimilar processes, the one adapted to subjects of small or medium size, the other suitable only for large animals. The former method, which is applicable to anything up to the size of a large dog, will first be considered. First attempts should be made on some subject easily procured; therefore, a rabbit has been selected for the purpose of the present description.

SKINNING SMALL MAMMALS

The specimen having been laid on its back and propped up, if necessary, with a few handfuls of shavings, the opening cut is made by a series of short downward strokes of the knife, whilst the fur or hair is parted by means of the finger and thumb of the left hand. This incision should not be too deep or the body cavity may be cut into; it should extend from a point at the base of the thorax or breast bone down to the vent (see Fig. 20). The skin should then be loosened as far as possible away from the body. By working the fingers of the right hand inwards by the side of each flank, and then in a downward direction towards the tail, the hind-limbs, and that part of the body to which they are attached, may be separated from the skin. It is now possible to thrust each leg outwards with the left hand, and separate the joints at the body by dislocating them with the point of the knife (see Fig. 21). After cutting through the base of the tail it is possible to turn the skin back and loosen it as far as the shoulders. Here the scissors are used in separating the fore-legs at their articulation with the shoulder blades (see Fig. 22). The skin can then be worked away until the bases of the ears present themselves. These are cut through as close to the skull as possible; and the eyelids are then encountered. In separating these from the skull, care should be exercised, the knife being used far behind the apparent junction of the skin with the bone. The actual position of the lid at this point cannot be easily determined, and a careless cut may cause a nasty gash in the skin just behind the eye. Skinning may then be continued right down to the tip of the nose, and then, unless the specimen be fairly small and destined for immediate mounting, the lips should be separated as close to the gums as possible, this operation effecting the entire removal of the skull and body.

The subsequent trimming up of the skin and limbs is a more lengthy operation than the removal of the body. The head being treated first, the double skinning or "pocketing" of the lips and eyelids should be performed. This consists in carefully following the outer skin of the lids and lips with the point of the scalpel until the extreme edges are reached. These in each case will appear as a black line, when the first finger of the left hand causes the skin to be inverted. It is needless to say that this operation should be performed thoroughly, otherwise good work is marred by the inevitable shrinkage, caused by the imperfect skinning, of the lips especially. In the case of the present example, on account of the cleft upper lip, the operation is a somewhat lengthy one if properly performed.

The ears may now receive attention. These, except in the case of very small subjects, require splitting to their extreme tips. The flesh and superfluous cartilage having been removed, the skin at the back of the ear, in each case, is separated from the cartilage strengthening it. As, on account of their length or some other characteristic, it is not always possible to turn these members inside out, the flat handle of the scalpel may be used to part the skin, the progress made being watched from without. Here again care is necessary, as the skin at the edges of the ear is very thin and easily torn. Thorough curing of the head should now be performed, and if the specimen is not intended for immediate mounting the ears should be returned into place.

In skinning the forelimbs, a hold having been taken with the finger and thumb of the right hand on the head of the upper joint, the left hand is closed on the skin, and the whole limb drawn out. Until the foot itself is reached no obstruction will be met with; but at this point the scalpel should be used, as it is necessary that skinning be performed right down to the tips of the toes. The removal of the flesh from the several joints may be quickly performed by severing the sinews at the lower end of each bone, and drawing the flesh upwards in a single piece; cutting it away at the top. The toes and pads, however, require scraping in order to rid them of flesh and tissue. In cleaning each joint care should be taken to prevent the dislocation of the bones by cutting through the side ligaments. Curing having been carried out, each joint should be roughly wrapped with strands of tow and the whole limb returned to position.

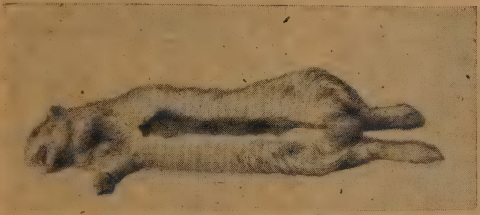


Fig. 20.—The Opening Cut

The hind-leg should next be treated in similar manner. Sometimes the long final joint may be difficult to return, in which case a cut should be made from pad to heel. In the case of a rabbit, rat, squirrel, etc., the tail should always, if possible, be drawn out of the skin. This is not a difficult matter, but with larger animals no amount of pulling will cause the vertebræ to move. In such instances a short opening cut made at the base of the under-side will assist matters; but as far as possible it is better to keep the skin of this member intact. If a hold on the bones be taken with a pair of pincers, and the left hand used to grip the skin at the base of the body on the inside, a strong pull will generally bring the bones, sinews, and flesh away all together.

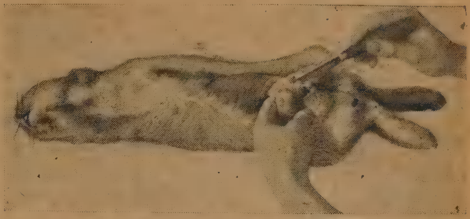


Fig 21.—Dislocating a Hind-leg

In curing the skin of the interior, a small puncture should be made with the scalpel at the extreme tip. As much preservative as possible should then be applied at the body end with the brush. By taking the skin on the outside between the finger and thumb and drawing it out, the curing agent may be caused to run throughout the entire length, and will appear and exude at the tip. The entire skin should then be cleared of any fat, tissue, etc., receive a thorough curing, and is then ready for making up.

This consists in filling the interior with cotton wadding, or tow, evenly inserted with the tow pliers, until the skin begins to assume something of the appearance of the dead animal. The opening cut should then be drawn together by means of a few stitches, and the specimen laid out on a board to dry. The finished "skin" should assume more or less the form of the specimen shown by Fig. 23, the fore-

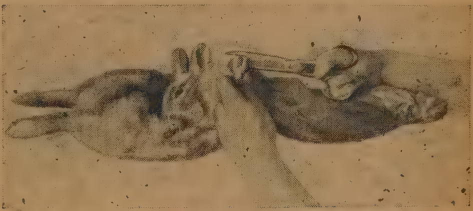


Fig. 22.—Severing a Fore-leg

legs being drawn well up on each side of the head and secured by means of thick pins passing through the pads and into the wood. The hind-legs should lie on each side of the tail with the pads downwards, the cotton-wool should be drawn slightly out through the lids, and the face caused to assume as natural an expression as possible. The skull should subsequently be partly cleared of flesh, dried in sawdust, and attached to one of the hind-legs of the specimen, together with a label giving full data, as in the case of a bird.

SKINNING LARGE MAMMALS

With a large mammal, the method of skinning is entirely different from that already described. From the upper and lower end of the central opening cut, two transverse cuts are made extending down the insides of the legs to the pads. These permit of the complete opening up of the skin, with the exception of that of the head and neck. At one time it was customary to extend the central opening cut right up to the chin, but this has now been avoided owing to the unsightly appearance caused by the sewing up. In the case of horned animals, however, a long Y-shaped cut is made on the back of the neck, the fork or furcations extending to the bases of the horns, in order to permit of the removal of the head. By such a method of cutting it is possible to make, with the exception of the neck and head parts, an almost flat skin, which may be laid out and cured in the ordinary way, or immersed in the curing solution. The bones of the legs, however, should be removed, together with the trunk, in the process of skinning, being afterwards cleared of flesh and preserved with the skull.

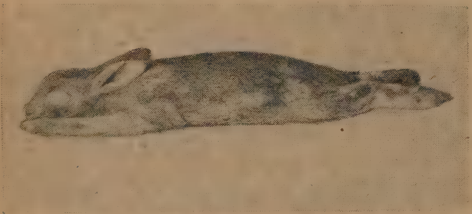


Fig. 23.—Finished Rabbit Skin

There is no "making-up" of the skin in the case of a large animal thus treated, beyond the placing of a small quantity of tow or wood-fibre between the skin of the neck in order to prevent the surfaces from touching, and for packing purposes.

After complete drying the hide may be simply folded into smaller compass and tied up to await further treatment.

Modified Methods of Skinning.—As in the case of birds, various deviations from the ordinary methods of skinning may at times be necessary. Many exceptional cases might be cited, but there may be no necessity to deal with them at length. The hands of the quadrumana—apes and monkeys, for instance—require opening up each finger or toe in order to remove the flesh; the flippers of seals demand similar treatment. The lower joints of the hind-legs in terriers and other small dogs should also be opened if difficulty is experienced in turning back the skins. Other modifications of detail need not be described, as the proper treatment is generally obvious.

TAKING MEASUREMENTS

The process of mounting a large animal entails the necessity for exhaustive measurements, and these may be taken either from the specimen before skinning or from the carcass. The former are, of course, of greater value from a scientific standpoint, whilst the latter are of more real use to the taxidermist in preparing his model.

The positions at which these measurements should be taken are shown in Fig. 24. They are as follow: A circumference of the neck below the head; B ditto on shoulder (the relative depth may also be taken at both points); C distance from the shoulder to the heel; D circumference of the body behind the fore-legs; E the same in advance of the hind-leg (here again relative depth should be taken); F distance from the top of the buttock to the heel; G distance from the base of the tail to between the horns, or top of the cranium in the case of a hornless animal; H length of the tail; I length of the tibio-tarsal joint; J length of the tarso meta-tarsus; K from the base of the tail to the front of the pelvis; L from thence onwards to the base of the neck; M, N, and O girth of the hind-legs at different points; P length of the humerus; Q length from the knee to the heel; R, S, and T girth of the fore-legs at different points; U distance from the point between same to the back of the skull. The measurements may be taken for the greater part by means of a flexible tape; those of relative depth with a straight rule.

For recording purposes it is convenient to draw a rough outline of the animal, and then to fill in the measurements as taken. It will be noticed that no reference hitherto has been made to the head. In the case of a large animal too many measurements cannot be taken by the beginner. Even a miniature model in pipe-clay showing the more striking characteristics may be made before the flesh is removed from the skull.

MOUNTING SMALL MAMMALS

As in the case of birds, there are many methods of mounting mammals. The several processes, more or less elaborate, may be divided into two groups, the one adapted to large subjects, the other for those of medium or small size. As it is chiefly with the latter type that the amateur has to deal, a description of a method of treatment suitable for a rabbit may be conveniently continued.

Limbs.—Presuming that the flesh has been removed from the bones, the eyelids and lips "pocketed," and the ears separated to their tips, proceed to "make up" or re-model the flesh that has been removed from the limbs.

First the pads should be restored with moist modelling clay. Four wires are then selected of sufficient thickness and about half again as long as the combined limb bones. These are inserted through the pads and passed up within the skin close to the bone. When their ends project a few inches beyond the head of the upper bones—namely, the femora in the hind-legs, and humeri in the fore- (Fig. 25)—they should be secured to the lower surfaces of the bones with spiral lashings of fine wire. The several joints of each limb may then be restored by twisting strands of tow on to the bones and wires, adding little bunches here and there to produce correct shape, and finally binding down the surface with hemp, or by the more speedy, though less easy, method of binding on lumps of fine wood-fibre roughly moulded into form. In each case, however, a layer of clay should be placed over the finished limb before it is drawn back into place within the skin.

Tail.—A model of the tail should be made up on a separate wire, by means of tow covered with clay. The wire itself should reach to the extreme tip of the skin, and it is a common fault with beginners to make the model too big, with the result that in forcing it in, the skin is split or broken across. Care should be taken to avoid this error in the case of any of the rodents (rats or mice), in which the tail is almost devoid of hair, as damage of this sort is difficult to successfully repair.

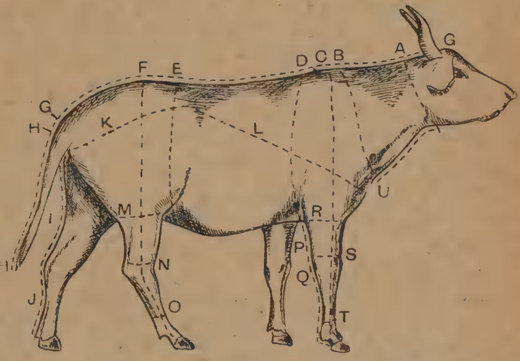


Fig. 24.—Positions for Measurements of Buffalo

Head.—Passing now to the head, the flesh removed from the skull should be restored by means of bunches of fine wood-fibre bound on with hemp. In the case of a rabbit, two of fair size will be required, one on each side of the lower jaw, extending some little distance to the back of the head, and upwards to the bases of the ears. The orbits also should be partly filled, and other smaller pieces added to the tip of the nose and sides of the upper jaw. These in every instance require to be bound into place, and it is convenient, after tightly filling the interior of the skull, to drive through the bone above the eye short wire nails, on which to twist the binding threads. In finishing off the restored head, these projections may be driven in flush with the bone. A final coating with clay will cover up deficiences, and render the whole surface of the model smooth.

In certain cases the skull itself may be required for other purposes, or may be missing from a dried skin, in which instance a model of peat, cork, or soft wood has to be made. In such circumstances careful attention to shape and contour, as indicated by the skull, or the shape of the head in the dried skin, is necessary, or a hopelessly unnatural expression will be given to this most important feature of the mounted specimen.

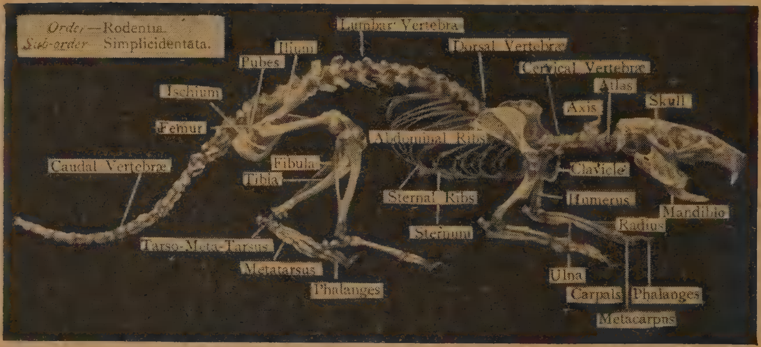


Fig. 25.—Skeleton of Mammal, with Bones Labelled

A body wire may now be selected about one-third again as long as the trunk measurement. It need not be very thick, as, with the exception of the head, it has nothing to support. One end should be pointed, and left projecting for some little distance, whilst a column or body core of tow or wood-fibre is twisted on to the lower part of the wire the exact length of the trunk removed. This body core should be, roughly, one-third, or even one-quarter, the girth of the actual body, and should be densely made and tightly bound with hemp. An easy method of forming a correct estimate of the required length of this core is to give the wire beforehand a sharp bend above and below to the extent of the known measurements. The projecting point may now be passed through the hole at the base of the skull, and, by piercing the bone, caused to appear between the orbits on the forehead. At this point it may be given a hook-shape bend, and the point returned to the interior of the skull. Now, by pulling the lower end of the wire while the body core is held in the hand, the latter may be caused to slide upwards, until its anterior part comes into close contact with the back of the skull. This will render the head immovably fixed to the body core, and cause the whole structure to become rigid. The lower end of the body wire may be then bent sharply round and passed through the tow or wood-fibre.

Ears, Eyelids, and Lips.—The model is now ready for inserting in the skin; but before anything further is done, the interior of the ears, the eyelids, and lips require filling with moist modelling clay. With the ears of a rabbit, this is rather a difficult matter to perform satisfactorily. The best plan is to work the clay into a thoroughly plastic condition by adding a little water; then roll it into a cone of fair thickness, insert it right up to the tip of the ear skin in each case, and then by gentle pressure flatten it out, so that it extends to the extreme edge throughout. Unless the filling of the ears is properly carried out, grievous shrinkage will appear on drying, sufficient to mar the whole appearance of the mounted animal. The lips and eyelids need not be unduly distended with clay; but they should be sufficiently well filled to allow for a certain amount of shrinkage of the skin, and also for the small quantity of tissue and flesh removed from the skull itself, which have not been taken notice of in the making up of the head model.

Inserting Model into Skin.—Now, in placing the head within the skin, care should be taken to see that the tip of the nose, or rather nasal bones, are placed in exact position within the snout. Then a couple of pins passed up the nostrils will fix the skin in place. The remainder of the head having been roughly modelled up, it will generally be found that the ears require further support at their bases, and this can be supplied by modelling clay, which can be inserted into the required position when the skin is partly turned back. This operation should be carried out whilst the back of the skull is still readily accessible. It often happens that a deficiency of this kind is discovered after it is impossible to rectify it, except by cutting the skin from without.

The projecting wire from the tail should now be affixed to the lower end of the body core by being passed through the tow or wood-fibre, and finally twisted round the entire column. The wires of the fore-limbs should also be attached in the same way, their free ends being twisted together with the pliers in order to render the members perfectly rigid. In selecting the point of attachment for the fore-limbs, reference should be made to the actual body. There it will generally be seen that the end of the humerus occurs in a position roughly in one-half the depth of the trunk, the remaining space between this point and the line of the back itself being occupied by the scapula or shoulder blade. Now, having ascertained the length of the neck, the wire of each fore-limb should be inserted through the body core at a position where normally in the animal's trunk the posterior margin of the scapula would touch the back.

Sufficient allowance should then be made for the length of the scapula in the limb wire, and a sharp bend made to make the humerus form an angle of nearly 45° with it. Reference to Fig. 26 will show the correct position of the wires and limbs in relation to the body core.

The attachment of the lower limbs may now be proceeded with. As will be seen in Fig. 26, the articulation of these members occurs almost at the end of the model. The beginner often makes the mistake of attaching them too far forward, with the result that the animal's body is rendered almost torpedo shape by the projection of the end of the column.

Inserting Stuffing Material.—The interior of the skin can now be filled with fine wood-fibre in small bunches, in the case of an animal of fair size, or with chopped tow in a small subject. This, of all the several processes connected with mounting mammals, appears to be the simplest operation, whereas it is really the most difficult. The stuffing material has to be inserted a little at a time by means of the tow pliers and stuffing rod, care being exercised to prevent the common fault of over-stuffing.

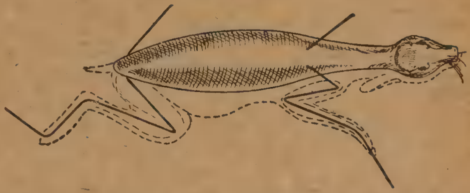


Fig. 26.—Diagram Showing Position of Body Core in Relation to Limbs, as Seen from Above

The contour of the muscles of the neck and shoulders is difficult to portray faithfully, unless the operator is well acquainted with the animal's appearance in life, and reference to a living specimen whilst the work is being performed will be an advantage. In the case of a rabbit, for instance, there is a certain abrupt but very graceful fullness below the back of the head, extending well between the fore-legs. The shoulder blades, moreover, slightly project, to form a small hollow in the centre of the back beyond the base of the neck. Attention should be paid to these two points whilst the filling is being inserted, and modelling carried out roughly from without at the same time.

Sewing-up Opening in Skin.—The skin should be sewn together down the opening cut gradually, a special stitch being employed, in which the needle is inserted through the flesh side only, passed over the edge on the one flap, and through the skin on the opposite side a little distance farther down. In filling out the actual trunk, it should be noted that the upper surfaces of the body core should remain in contact with the skin of the back. The point at which the ribs end on both sides of the body should be suggested, in a great number of the carnivores (cats especially), by a slight diminution of the girth and falling in of the flank. In the present example, however, as with various other rodents, the reverse of this condition should be slightly emphasised. The top of the pelvis, moreover, requires a certain amount of filling in order to produce a certain extent of squareness in the generality of small- or meduim-size mammals; but this is not an inflexible rule. It is well to leave a small part of the opening cut unclosed to admit further stuffing material if necessary.

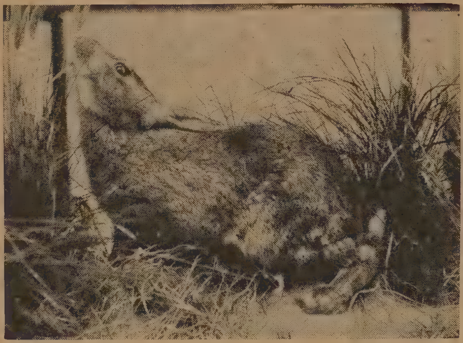


Fig. 27.—Mounted Specimen of Rabbit

Pose and Shape.—The thread having been made secure by means of a knot, the specimen can now be bent roughly into position, and placed on its legs, so to speak, on a piece of peat or some other convenient stand, the projecting leg wires being passed through the temporary mount, and attached in the same manner as described in the case of a bird (see chapter in the first volume). Superficial modelling of the body may now be performed, a slip of wood being used to cause depressions where necessary by a series of gentle taps, and a curved awl employed for pulling out the skin where it is too flat. Now, if the filling has been properly inserted, the skin will almost fall into shape of its own accord, but if the skin has been overcharged, no amount of drumming on its bloated flank will mend matters, and the only thing to be done is to extract the necessary quantity of superfluous stuffing through the orifice provided for this and kindred purposes.

Considerable time may be spent with advantage by the beginner in the working up of the shape and pose of the body. There are numerous niceties of detail which combine to make a well-mounted specimen. Every animal has its characteristics in this respect, and it would be futile to attempt to lay down any definite rules. Two points, however, will generally require attention: the clear indication of the "hamstring" (this especially in the case of smooth-coated dogs), and the formation of a more or less sharp depression between the shoulder blades. In both cases, stays of wire bent into L-shape, one arm being pointed and thrust into the skin, will be necessary to retain the depressions thus formed whilst the specimen is drying.

Modelling the Head.—Attention may now be given to the head. This feature alone forms a taxidermic study by itself, and a fuller description of treatment than is here possible will be given in a subsequent chapter. The lips and nose, plastic on account of the clay lying under the skin, should first be worked well into form, and secured therein by means of pins. The awl will be found most useful for this work. The eyelids demand similar treatment, and the artificial eyes may then be inserted. Upon the care expended on the eyelids depends the whole expression and character of the animal. In the specimen of a rabbit shown in Fig. 27, part of a group in the

Herts County Museum, an effort has been made to portray the pose and expression, especially in the eyes, of extreme and sudden terror, caused by a stoat (not shown in the illustration), which has leaped on to its back.

The ears, the treatment of which has already been described, sometimes require to be reinforced by means of wires passing down their length and into the base of the skull. In the case of very small animals (mice, etc.) it is not necessary to open out these members; but in such instances the ears should be filled from without with moist clay, which on drying will retain them in correct shape and position. When the ears are large, as in the present example, two stays of stiff card should be fixed, one on each side, and secured by means of pins passing through the card and ear in some inconspicuous position.

MOUNTING LARGE MAMMALS

"Direct Paper Process."— Before giving a description of a method of mounting large mammals practicable by the ordinary amateur, a word or two may be said with reference to a method termed by its inventor, Montagu Browne, the one-time curator of the Leicester Museum, "the direct paper process." By casting in plaster from the body after the removal of the skin, a papier-maché model was formed, which gave in the main accurate proportions and form, on which the skin was mounted in the ordinary way. Such a method possesses certain advantages above all others, exact distances wherever bones occur are ensured, the correct positions for the limbs with reference to the trunk, etc. Yet it is apparent that the flexed muscles of a dead animal can in no way be compared with those of the creature in life; and however fresh the subject may be, there is an inevitable collapse of the flanks and throat. The necessity for "working up" a model thus formed to remedy these defects at once destroys its value as an exact replica of the creature's living form; and it would be possible to build at least two models from measurements, making every allowance for deficiencies, in half the time occupied in making the papier-maché model. Anyone, moreover, who has tried to pose an animal's dead body as if it were alive, knows the hopelessly unreal appearance it invariably presents, this being due entirely to the causes mentioned.

Constructing the Model.—Earlier in this chapter details in regard to measurements, etc., have been given, and the rough outline of the body giving these particulars should be carefully studied before any attempt is made to begin the making of the model. In Fig. 28 is shown the framework on which the model is made up. The contour of the actual trunk is constructed from matchboarding, joined together with transverse strips of wood. This in turn supports four blocks of batten, two on each side of this central framework, corresponding with the width of the thorax or ribs on the fore-part of the body, and that of the pelvis in the hind-quarter. The measurements for both of these may be obtained from the diagram made from the original body. The blocks need only be lightly nailed in position, as their main attachment to the framework is by means of the rods, which, passing up behind the several limb bones, are inserted right through both blocks in each pair, and secured by means of threaded nuts. The rods need not be of undue strength, as it is often necessary to slightly alter the position of a limb after the skin has been

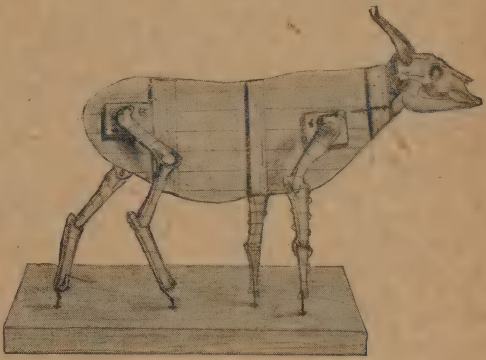


Fig. 28.—Central Board with Rods, Limb Bones, and Skull Attached

put on the model. As will be seen from an examination of Fig. 28, they should each be roughly one-third again as long as the extent of the several bones retained in the construction of the limb model. At the upper end of each a thread should be cut to receive a nut intended to secure the rod after it has passed at right angles to the limb through the shoulder or pelvic blocks, in the fore- or hind-quarter, as the case may be. At the lower end the thread must be considerably longer, in order to receive two nuts, one on each side of the wooden stand. The surface of the rods, which are made of charcoal iron, should be painted all over to protect them from the corroding influence of the alum and salt used in curing.

In constructing the model, the position of each limb should be decided upon, and the rods bent in accordance with the contour of the several bones, the upper end in each instance being left free for insertion through the blocks, and the lower end for a short distance to accommodate the hoof, and then to pass through the stand. The rods should then be fixed roughly into position, and the framework put on its legs on the stand, through which holes have been bored with a centre-bit to receive the rods. The bones may then be lashed into place by means of galvanised wire, each being placed in advance of the rod. The position for the upper nut should then be ascertained, and the lower one run on and tightened. The framework will thus be rendered fairly rigid.

The skull, which has previously been freed of flesh and cleaned to a certain extent, may now be attached to the framework of the neck in the following manner: The base of the skull having been removed with a fine keyhole saw, a piece of batten is accurately fitted to the interior in such a way that a wire nail or two, driven through the frontal bone, will secure it firmly in position. Two moderately-light lengths of rod are then fixed into auger holes made in the batten a little distance apart on the same plane, in order that they may pass the one on each side of the central framework, to which they may be secured by means of staples. By such a means of attachment a certain degree of flexibility is accorded to the head of the model, which may be a desirable feature if a slight error in determining the pose is made and discovered only when the skin has been mounted.

Making up the Model with Wood-fibre.—Next comes the more arduous task of making up the model with wood-fibre. The limbs should be treated first, the fibre being wound, piece by piece, round the rod and bones, until each point accords in form and girth to what is known about the original from the measurement diagram. Presuming also that the appearance of each member in life differs materially from that presented by the carcass, reference, whenever possible, should be made to a living animal, and the wood-fibre transplanted here and there, to a certain extent, to give the tense appearance of muscles in action and other similar points. In any case, the hamstrings in the hind-legs should be well emphasised. This can be carried out by making up on a separate wire a model of the tendon. This may be attached by boring a hole through the projecting bone at the heel, and passing the wire through it, the other end being bound into the upper part of the limb.

The head may now be made up. As this feature of the work will form the subject of a further chapter, it may be sufficient at this point to deal briefly with the method to be adopted in the case of an animal with the mouth closed. In such an instance, small wire nails should be driven into the skull, and their ends left projecting, these forming convenient pegs, over which packthread may be twisted in the process of binding on bunches of wood-fibre to restore the flesh removed.

In making up the model of the trunk itself, the first thing to be done is to drive in tacks at frequent intervals along the edges of the central board, leaving their heads projecting. These, as in the case of the skull, are intended for the packthread. The wood-fibre can now be placed in layers throughout the entire surface on the one side of the central board, each layer as it is added being well bound into place with packthread. The amount of this latter material required in the making up of a large model is considerable; and as density is the main thing to be aimed at, it is a great mistake to be sparing or economical in its use.

By a succession of layers the trunk on the one side will gradually assume the required girth, and then follows the addition of more wood-fibre in certain areas, indicated in the present subject in Fig. 29, where protuberances and gentle swellings occur. It would be useless to attempt to describe these minutiæ in detail, as such characteristics vary with different types of animals. In the present example, a short-horned buffalo, there are many characteristics of build similar to those exhibited by certain breeds of cattle—looseness of the throat, gentle fullness of the shoulder, and a certain squareness of the buttock. It is best to build up one-half of the model completely, in order to have a copy from which the other side may be moulded.

When the proportions are correct, the surface of the wood-fibre may receive a fairly thick layer of clay. A covering throughout is not always necessary; but the legs, head, and parts of the neck, destined to receive fine modelling, should always be so treated. In short-coated animals, a few veins should be shown on the legs and elsewhere, and these may be simulated by stout wire or thick string, stretched across the surface of the model.

Preparing Skin for Mounting.—Leaving the model now for a time, next prepare the skin for mounting. It is here presumed that it is in a fresh or "green" condition, and cured in a solution of 1 lb. of alum and ¼ lb. of salt in 1 gal. of water, or by another of the processes described earlier in this chapter (p. 312).

In the case of a large animal, the hide requires to be put through a thorough "skiving"—that is, a process of thinning down—in order to render it completely supple and capable of taking the impression of fine modelling. On the thoroughness with which this is carried out depends a great deal of the appearance of the mounted specimen. As in the case of a small animal, the ears should be well filled with moist modelling clay.

A model of the tail made up on a separate wire, not rod, is next placed inside the skin.

Mounting the Skin.—The hide is now ready for mounting. The first thing to be done is to work it roughly into place over the head and neck. If the model in these two parts has been correctly formed, the fit, except for nose and lips, should be almost perfect. The remainder of the skin may then be placed roughly in position over the back of the model, and the projecting end of the tail wire fixed securely through a hole bored to receive it in the central framework in its correct position. Leaving the fore-part of the head a while, after having worked the skin into a correct relative position, the neck and back of the head may be attended to. Then it may be necessary to add a certain amount of extra filling, which may be inserted by means of the stuffing rod and tow pliers. If the model is well formed, the bases of the ears should alone require serious attention.

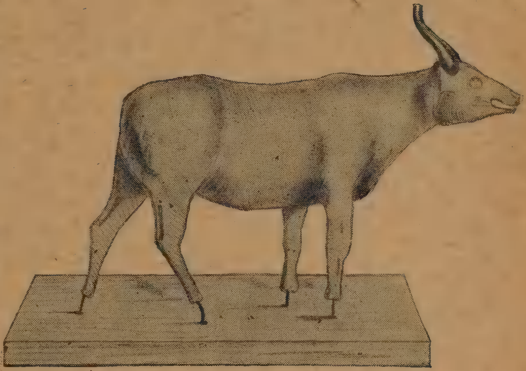


Fig. 29.—The Finished Model

The Y-shape cut in the case of a horned animal should now be sewn up, stitching being begun at the base of each horn in turn, the central cut being closed afterwards. The hoof of each fore-leg should then be placed well in position, and its interior, and that of the "ankle," so to speak, filled closely with tow and wood-fibre. The skin can then be brought together and sewn up, rough superficial modelling being carried out as the cut is joined. Both fore-legs having been similarly treated, the central opening may be sewn together, further stuffing material being added where necessary.

In the vicinity of the elbow the beginner is often apt to fill the skin out where in the living creature wrinkles occur in the body. The filling at this point should be a lump of clay, intended to receive surface modelling. The hind-legs may now be treated in the same way as the fore-legs, and the central cut sewn up.

Surface modelling may now be carried out, a short slip of planking being used to beat the skin well into place along the flanks and back. Sometimes a round-headed mallet may be required to form depressions, and not unfrequently the skin itself may have to be cut in some inconspicuous position to admit more stuffing material, inserted with the rod. At certain points, moreover, it is necessary to drive pointed wires through the skin and into the model, in order to prevent the hide from springing out of place on drying.

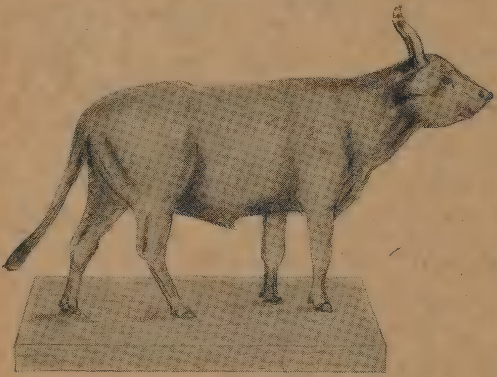


Fig. 30.—The Mounted Specimen

Returning now to the head, the eyelids should first be filled with clay, moulded into form, and the artificial eyes inserted. The nose and lips should also be modelled up, the skin of the upper lips being drawn well down and over the margin of the lower jaw. The ears are stiffened with fine wires passed down them, and with "stays" of stiff card pinned together. Fig. 30 shows the mounted specimen at this stage.

There have now been described what may be termed "exact methods" of dealing with small and large quadrupeds, processes in which every attention is paid to the requirements of correct anatomy. By adopting such means of mounting specimens, the worker cannot depart very far from the general form and contour of the living subject. There are numerous animals, however, which, on account of some external characteristic, do not demand such careful treatment. Rigid attention to anatomy is to a certain extent thrown away on them ; and as time-saving is often of consequence, some of these exceptional cases will be detailed.

Mounting a Mole.—It is obvious that the building up of an internal framework in mounting a mole would be quite unnecessary. In such an instance all that is required is the insertion of wires up each leg, another to support the skull, and the ends then twisted together. The interior of the skin may be filled with sawdust or with finely-cut tow, the opening cut drawn together, and superficial modelling carried out. It is possible perfectly to mount a specimen in this way in less than ten minutes.

Mounting a Bear. — Long-coated animals, such as bears, badgers, and certain kinds of dogs, in which the legs are partly concealed by the fall of hair from the flank, do not require very careful modelling on either the limbs or body, except in certain areas, and the necessity for building up an internal model may be largely dispensed with. A bear in an upright position holding a salver for the reception of visiting-cards forms a striking addition to a large hall ; and such a subject is by no means beyond the capability of the amateur. In this case the central framework may consist of a length of batten roughly equal to the extent of the body. Through it, a short distance from each extremity, two holes should be cut with a centre-bit. The skull, restored as already described, is then attached to the upper end on a short length of iron rod corresponding to that of the neck. In attaching the rod to the batten, the end is sharpened with a file, passed through a hole bored in the wood, bent sharply round into a right angle, driven flush with the surface of the batten, and finally secured in position by means of a few wire staples.

Returning to the skin, the opening cuts of the legs should be sewn up. Four rods may then be selected for the limbs, those for the hind-legs being considerably stouter than the others, since they are destined to support the entire weight of the body. These, moreover, should be fitted with the usual pair of nuts at the lower ends; but the upper ends, in common with those of the rods, for the fore-limbs, should be simply sharpened to a point by means of a file. The entire length of each rod should be roughly one-third again as long as the extent of the several bones composing each limb for which they are intended. The rod in each case should be passed through the pad, and allowed to project for some distance beyond the head of each upper bone, namely, the humerus in a fore-leg and the femur in a hind-leg. Then, after it has been bent roughly into the required form, it may be secured to the bones by means of spiral lashings of wire. The limb itself may then be modelled up in the usual way, with wood-fibre bound into place with packthread.

The sharpened end of each rod may then be inserted through the hole in the batten. Thus the two rods for the hind-limbs pass in opposite directions through the lower hole, and those for the fore-legs through the upper.

The projecting ends should then be treated in a similar manner to that described for the neck rod. The filling can then be inserted, a beginning being made on the neck, and the central opening cut, then drawn together gradually as the stuffing proceeds. As, in the construction of this simple framework, no allowance has been made for the space occupied in the animal's body by the scapulæ or shoulder blades, a considerable amount of filling will be required between the upper surface of the batten at the insertion of the fore-limbs and that part of the skin directly above it. Moreover, as the width of the batten in no way corresponds to the thickness of the trunk, either between the fore-legs or across the buttocks, although the heads of the fore-and hind-limbs have been brought directly in contact with the wood at both points, a fair quantity of material will be required to fill out the skin across the body at both points. In all other respects the treatment in mounting is similar to that already described. Fig. 31 shows the correct position for the batten and rods in the subject mentioned.

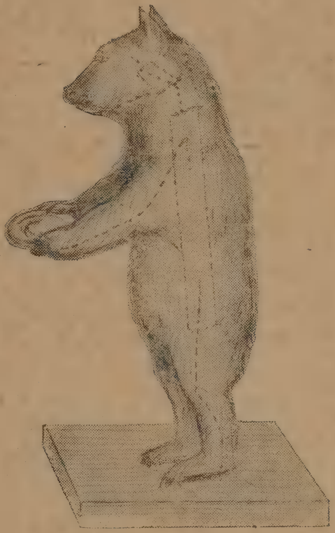


Fig 31.—Bear Mounted, Showing Position of Rods and Central Framework

Mounting Bats.—Passing now to other considerations, it may be mentioned that bats generally are difficult to mount successfully. Not only is the skin very fragile, but the wing membrane is very liable to damage. Specimens of this class are generally seen with the wings completely flattened and heavily varnished, though the reason for the latter treatment is difficult to conceive. The flattening of the wing membrane is obviously a travesty of nature, due to the fact that the specimen after stuffing has been laid out and "set" with strips of card, much in the same way that butterflies and moths are treated. Such specimens, it may be added, are usually displayed "spatchcocked" on to a piece of sky-blue board.

Now in giving more considerate treatment to these most interesting subjects, it may be mentioned that the opening cut should be made on the surface less exposed to view; skinning may be performed with equal facility from the stomach or back. The legs, wings, and tail should all be wired to a central body core. The wires for the wings should be passed down the joints composed of (*a*) radius and ulna, and (*b*) humerus, in each member.

It is useless to attempt to insert the point higher up than this, and it is difficult enough to perform the necessary amount of wiring without splitting the membrane either on the joints themselves or elsewhere. It is not difficult, however, to insert the leg and tail wires. Before the specimen is sewn up, another wire should be bolted to the centre of the body core. This is intended for a temporary or permanent support for the specimen when ready for casing up.

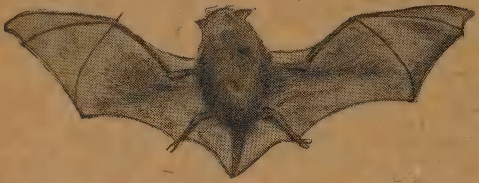


Fig. 32.—Mounted Specimen of Pipistrelle Bat

It is, perhaps, unnecessary to state that the wing membrane, when the animal is in flight, would bulge considerably by reason of air pressure. Now, although specimens are very apt after drying to partially lose this feature, however carefully it may have been induced in the first place, attention should be paid to the wings with a view to giving them correct form. The following means cannot be bettered. It may be mentioned that there are several other methods, but none so straightforward. The specimen having been laid front downwards on a piece of wood, a few light lashings of thread are passed over the wings close to the body, these being applied sufficiently loosely to permit of easy and free movement of the specimen. Cotton-wool is then packed under each wing, piece by piece, until the membrane is expanded to its fullest extent. The secondary effect of this treatment will be to slightly raise the lower surface of the creature's body off the board itself. The wings having been arranged in the required position, a few fine entomological pins may be used to secure the margins. A specimen mounted by this method is shown by Fig. 32. The membrane, on drying, requires little further treatment; if anything is used to restore the fresh appearance, which in certain species may be partly lost, a little glycerine should be applied.

Difficult Jobs.—As in the case of birds, mammals which from some cause or another seem almost hopeless may sometimes have to be dealt with. Skinning is often difficult, from the fact that the specimen has been kept too long, and is, consequently, in "high" condition. The hair or fur slips away at the least touch. Much can be done to improve the condition of the skin if an opening is made in the abdomen and concentrated formalin injected, though, needless to say, the pungency of the chemical is most trying to the eyes and nose. In any case, the loose hair or fur, if it comes away in quantity, should be carefully collected and replaced when the specimen has dried.

Again, in certain cases, the skin may have been cured successfully, but removed from the body in such a way that no indication is left of the form or expression of the subject. In some farmhouses and keepers' lodges may be seen the skin of some rare British mammal preserved by the primitive method of pepper and salt, after stretching on a board. The specimen is often mounted as an ornamental mat, and has undergone a certain amount of trimming. The specimen shown in Fig. 33, a polecat, was mounted from a flat skin which was very imperfect. Now whether the subject is one such as described or one already mounted badly, and which it may be required to improve, the treatment is similar. In the first place, by continuous soaking in the curing solution, followed by as vigorous currying as the condition will permit, the skin should be rendered as soft and pliable as possible. By a judicious stretching in parts where trimming has been performed, the deficiency may be largely overcome.

When the skin of the limbs has been lightly sewn together, there will generally be some indication of the relative position of the elbow in the fore-leg and the heel and knee in the hind, and this will materially assist in making up the joints. Again, the pose selected for the mounted specimen will help largely towards covering up certain defects. In the present example, for instance, the lower surfaces of the body and limbs are non-existent; but this is not noticeable. Considerable damage to the chin and upper part of the neck is disguised entirely by the carriage of the head, and much trimming of the skin in the neck and fore-part of the body was overcome by the stretching of what remained.

It is advisable to keep odd pieces of skin and hair for patching purposes. The same thing applies to mammals as to birds; it is often possible to turn out one good specimen from two bad ones.

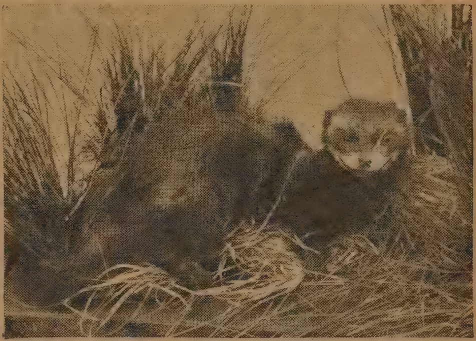


Fig. 33.—Polecat Mounted from Skin Mat

Cleaning Primus Stove Burners

The iron burner in the Primus oil stove and other wickless oil stoves having vaporising burners is carried round and over the flame. The oil in the reservoir is forced up to the burner by the aid of a small pump, like a bicycle pump, fixed in the reservoir. This pump compresses the air in the reservoir and thus forces the oil up a pipe that is carried from the burner nearly to the bottom of the reservoir. A little heat around the burner (provided by burning methylated spirit in the iron cup of the burner or by burning paraffin oil by means of a special contrivance) is required to start the stove; this heat vaporises the oil as it passes over and around the burner, and when once the stove has started the heat from the flame keeps the tubes in the burner sufficiently hot to vaporise the oil as it passes through them. In use, the nipple of the burner must be kept clean with the pricker provided. In time the burner itself may become choked; a deposit collects in the tubes, but it can be prevented to some extent by always working the stove at a good pressure. The average life of a burner in daily use is one and a half to two years. Clogged burners can be treated in the following way: Remove the burner from the stove and the nipple from the burner (a tiny box spanner is useful for this purpose, and can be bought from ironmongers). Attach a piece of thick wire to the burner, and put it in a clear fire until red-hot. While it is heating, put in a preserve jar ½ pt. of water, and gradually add to this 1 oz. of sulphuric acid (the acid must be added to the water, and not the water to the acid). When the burner is red-hot dip it into this solution, standing well clear of any splashes. Wash well by running water from a tap with a good head to it through the burner. Replace the nipple, and put back the burner on the stove, and it will work as well as a new one. In very bad cases the bath should be repeated.

Curing Smoky Chimneys

An insufficient supply of air is often the cause of a chimney smoking, but it is sometimes found that the evil exists not so much in the quantity of air as in the direction from which it comes. In very many cases it is found that opening the door of a room will remedy the evil; but, though this may be efficient as a temporary measure, it is evident that some means of absolute cure will have to be devised. A ventilator similar to those used in external walls will, if fixed near the ceiling of the room, often cure a smoky chimney, besides ventilating the apartment. A scheme for allowing fresh air to pass through a grating placed in front of the hearth has been advocated as a successful remedy for very bad cases.

Another case of sluggish draught is cold air getting in the corners of the ordinary-shaped flues, and the longer the flue the more liable is it to be affected in this way. The object aimed at is to cause the up-draught to be continuous, and, as far as possible, to do away with the least suspicion of a down-draught.

In the case of smoky chimneys in an open and exposed situation, a frequent cause is down-draught. A cure may be effected by using a special chimney cowl (a good one has already been illustrated in these pages). Some cowls permit the smoke in ordinary weather to escape from the top in the usual way, and in strong winds and gales to escape at a lower level in the cowl. As a general rule, it may be taken that for a high chimney a cowl of medium height is best, so as to lessen the chance of its being blown down in high winds, whilst for a low chimney a cowl about 5 ft. high is suitable.

Probably the most troublesome cases to deal with are those in which the chimney is lower than the adjacent buildings. Galvanised-iron tallboys can be obtained up to about 10 ft. high, and might answer, but where there is a great difference in the height of the chimney and that of the adjoining houses a galvanised pipe with a cowl on top carried up to the level of the buildings may be employed. Where a very simple remedy is needed, terracotta louvred chimney pots may be used. Choose one that fits the present chimney pot, and so saves alteration; see that it is so constructed as not to be damaged when the chimney is swept. The lighter a revolving cowl is made, consistently with strength, the better; one that requires a very heavy wind to turn it should be avoided. A cowl in action should be nearly noiseless. The iron and zinc chimney pots known as "tallboys" are to be had in zinc as thin as 10 gauge and about 7 ft. in height, and in galvanised iron in 20, 22 and 24 gauge, and from 6 ft. to 10 ft. high. It is a mistake to suppose that any revolving cowl will keep in order year after year without being examined and oiled occasionally, although some of the best contain oil enough to last for years; such cowls often have their internal fittings of brass or copper, either of which adds greatly to the durability.

Open Ranges.—In the case of open ranges, the most prolific cause of smoking is the large open space that exists over the range and forms the mouth of the chimney. The draught in these ranges is not very keen at the best, and the large area allows quite cold air to rest there and to pass freely into the chimney, with the worst possible results on the up-draught of smoke and heated air. This is overcome by the use of a blower, which is a sheet of metal carried across the front of the range opening at the top, from jamb to jamb of the mantelpiece. This causes all air entering the chimney to come closer down to the fire and receive warmth, for while cold air impedes the up-draught, hot air accelerates it. A cranked metal pot will often prevent the down-draught, whilst a blower will stop the general smoking. The blower can be made temporarily of cardboard or paper to find the depth required.

Close-fire Kitcheners.—It is unusual for close-fire kitcheners to give trouble by smoking, and, unless the cause is down-blow (which only occurs when the wind blows from certain quarters), it must be concluded that the range is not properly fixed. Supposing the chimney is clear, it should be ascertained whether the brickwork of the chimney above the range is well clear of the flue outlets. There should be at least 12 in. clear space between the flue outlets at the top of the range and any brickwork that may come above them. If all is right in this direction, then ascertain whether there are any means by which air can enter the chimney from the room without passing through the fire, which is a common cause of kitcheners working badly, though it may not always make them smoke. The range should be set sound and air-tight, and there must not be any other flues running into the range chimney, except, perhaps, the copper flue, which must have a damper, to be closed when the copper fire is not alight. There must not be openings of any kind by which air can pass into the kitchen chimney except it go through the fire. It must be ascertained that the soot doors are complete and in their places, and that there are no apertures in the chimney. The position of the fire in its relation to the room door need not be considered with close-fire ranges.

"Dog" or Basket Grates.—If the adoption and continued use of the "dog" grate depended on its heat-giving and economical qualities it would have long ago been obsolete, but in many residences this type of fire is still being fixed because of the decorative effect that may be had with it. In the first place, the grate occupies a tiled opening or recess, and this can be given a handsome appearance when cost admits. Then the grate itself is often a work of artistic merit and beauty. Being usually of wrought iron, there are practically no limits to the fine effect that may be obtained.

The "dog" grate (which is no more than a square-shaped wrought-iron basket to hold fuel) placed in a tiled recess which has the mouth of the chimney at the top, provides the worst possible conditions under which a fire can be expected to burn successfully without sending a fair proportion of its smoke into the room.

Everyone has at some time seen an example of the old-fashioned open kitchen range, one that has an open exposed fire of good size, the smoke from which passes away up the chimney mouth yawning above it. These ranges nearly always give trouble by smoking if special means are not adopted to prevent it. The smoke from the fire shows an inclination to rise and get away up the chimney, but there appears to be some invisible resistance offered and a part of the smoke comes either pouring out or else a little oozes out into the kitchen.

The foregoing is referred to as it must be familiar to every one, and a glance at any dog grate standing in a tiled opening will show that the working conditions are the same as those just described. The cause of the smoking is the freedom with which cold air can get to the chimney and hang about in the upper part of the range or grate opening. It is cold air that offers resistance to the ascending current of warm products and smoke, and this happens with the old open range and the "dog" fire alike.

It will be at once seen, therefore, that if the free ingress of cold air to the chimney, or to the area above the fire, is the cause of the smoking, a remedy will be found in preventing this. This is quite correct, and, with the old open range, the remedy usually exists in the form of what is known as a "blower." This device, when in a kitchen, is a tinware sheet extending right across the range opening from side to side and coming down from the top to a depth that is found sufficient to effectively stop the smoking. As a rule the blower is about 10 in. deep from top to bottom, extending right across, so that it might be said that the upper part of the opening is brought down 10 in. nearer to the fire.

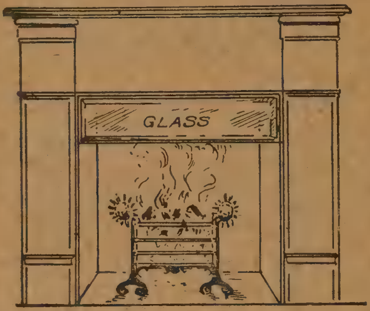


Fig. 1.—Glass Blower to Restrict Ingress of Cold Air to Chimney

A neat blower can be made of glass, as Fig. 1 shows, it having bevelled edges, and being fitted with a brass frame. Leaded stained glass can also be used.

To find the correct depth of blower, trial can be made with paper, cardboard, or linoleum, a piece being cut and fastened up as a blower, and its depth decreased or increased as found possible or necessary, until the best effective depth is ascertained. After this it is only necessary to measure up and make or order the better finished blower.

Another remedial measure takes a quite different form, and is shown in Fig. 2. With this the upper part of the opening—that which constitutes the mouth of the chimney—is quite closed in by a sheet of iron fixed horizontally as the sketch shows, and this is as soundly fitted as possible all round the edges. Previous to being fixed, there is a hole cut in it to receive the upper or small end of the vertical funnel piece shown; while, besides this, there should be a sliding door to admit of the sweep passing his brush through when the chimney requires cleaning. This door is not shown.

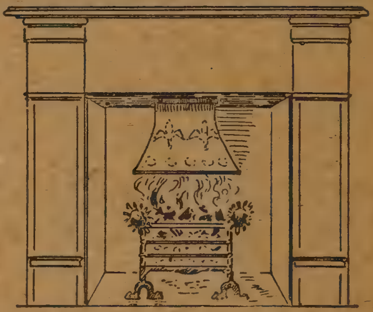


Fig. 2.—Mouth of Chimney Closed In with Iron Sheet

The funnel piece inverted over the fire is shaped like a square trumpet mouth, and its lower opening is in size a little larger than the top of the grate both ways. The material of which it is made may be any metal, but is usually in sheet copper or brass so as to bear polishing, and a simple design can be hammered in the front surface.

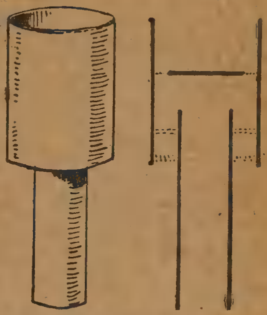
As to the height above the fire at which the funnel opening should be, this must vary with the draught and other conditions. A distance of 10 in. from top bar of grate to lower edge of funnel might be called a normal space, but the better plan, when possible, is to have the upper, smaller end of the funnel slide closely through a collar affixed to the opening in the plate above. The height can then be adjusted to give best results. An endeavour has been made to show this arrangement in the sketch, and there have to be two small set screws in the collar to fix the funnel permanently when its best position has been found.

Curing Down-blow with Special Chimney-pot.—Many cases of smoky chimneys are due to down-blow, which is recognised by its occurring only with certain winds—winds that blow over or against adjacent buildings, trees, etc., that are higher than the suffering chimney. And when it is occurring, the down-blow is seldom a steady descending current, but comes down the chimney in irregular gusts, as the force of the wind varies.

The remedy is to fit to the top outlet of the chimney a specially designed pot or "cowl" to prevent the wind from entering.

The special pot or top shown by Figs. 3 and 4 has the great merit of being distinctly successful in most cases. It consists of a simple tube at the lower part, this fitting closely into the existing chimney-pot. If no chimney-pot exists, then the lower tube must be made longer and have a flanged base to rest on, and be cemented to the brickwork. There should be a height of 4 ft. from brickwork to the lower edge of the upper case portion.

The upper part of the device is a length of tube of larger size, secured to the lower tube by stays, as indicated by dotted lines in Fig. 4. Within the upper tube is a disc, the diameter of which is midway between the two tubes; it is secured to the outer tube by three or four light stay rods or strips. The dimensions of the parts will vary a little with the different sizes required, which are usually: lower pipe, 8 in. for bedroom chimneys, 9 in. for living-rooms or kitchen chimneys, and 10 in. for large kitchen chimneys. Taking 9 in. as the commonest size, the lower tube will be 9 in. diameter and 3 ft. total length (longer if it has to go down to the brickwork as already stated). The upper tube will be 15 in. in diameter and 2 ft. high. The inner metal disc will be $12\frac{1}{2}$ in. diameter. In certain cases, the writer has had the disc made adjustable as to the height at which it shall be above the lower tube. This is done by having three $\frac{5}{16}$ in. rods or bolts riveted on the plate, the ends extending through vertical slots cut in the outer case. The projecting ends are screwed and have nuts on them, so that by tightening up the nuts the disc can be held in position at different heights. The whole can be made in zinc or galvanised sheet-iron, the latter for preference.



Figs. 3 and 4.—Elevation and Section of Chimney-pot to cure Down-blow

Making a Garden Path

Gravel Path.—For a well-made narrow gravel path excavate over the site to a depth of about 9 in. below the intended finished level. Fill in 6 in. of this with broken bricks, good hard clinker, or broken stone, and ram this well so as to consolidate it as much as possible. On the top lay gravel and sand and roll with a garden roller.

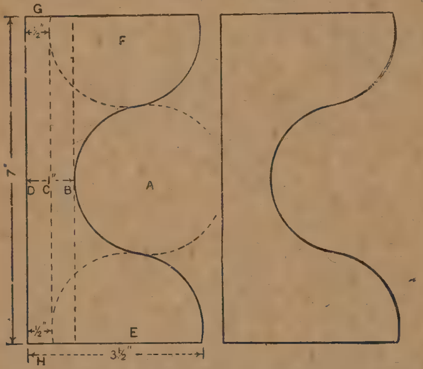
Asphalt Path.—To make an asphalt path, excavate to a depth of 9 in. Put in the edging or kerbs of the path, and fill in the foundation as recommended above. The asphalt is laid in two layers; the bottom one, about 2 in. thick, is composed of broken bricks or limestone broken to about 1 in. gauge and mixed with melted tar and pitch. The broken stone is placed in a heap on a wooden platform, the tar is poured over the heap, and the whole mass turned over several times with spades. Let the stuff remain thus for a week or two before laying. A local merchant will supply the tarred material ready for laying. Lay the bottom course to a depth of 2 in., roll it well, and finish off with a coat of similar material, but made of limestone only (no broken bricks) broken to a gauge of not larger than ½ in. This finishing coat should be rolled until firm and smooth.

Concrete Path.—A concrete path can be made by excavating to a depth of 4 in. Fill in 3½ in. of this with a rough quality of concrete, made by mixing one bag of portland cement with two barrow-loads of sand and five barrow-loads of broken bricks or stone. With the flat side of a spade beat the concrete down and allow it to set. The finishing coat, about ½ in. or ¾ in. thick, should be composed of equal parts of portland cement and clean, sharp sand, laid on carefully and smoothed with a plasterer's float.

Flagged Path.—A very excellent path can be made of concrete flags, which can be bought ready-made, 2 in. and 2½ in. thick, and 18 in. square. These should be laid on a bed of cinders and sand, and have joints pointed with cement mortar. Much the same applies to the more expensive stone-flagged path.

Making Scoops

EMPTY condensed-milk and other tins may easily be converted into scoops for flour, rice, colours, etc. A small pair of tinman's shears is the only tool necessary. A separate template will be required for making each different size tin; but the method of drawing the curves is the same in each case. To make the template, stand the tin on end on a piece of thin card or stiff paper, and draw a pencil mark round its circumference, thus forming a circle A (Fig. 1). To the left of the circle, and just touching its outer edge, draw a straight line B to a length equal to twice that of the tin. Draw two other similar lines C and D parallel to B, at distances of ½ in. from each other. Describe circles E and F on each side of A, so that they just touch it and line C respectively. At each end of D, and at right angles to it, draw the lines G and H to a length equal to that of the tin. Cut out the cardboard along the lines D, G, and H, and the solid parts of the circles, as shown in Figs. 1 and 2, form the template for that size tin. The template is held in position on the tin, and the cutting line then pencilled on the tin. See that the centre of the template comes over the seam of the tin, so that the greater portion of the seam is cut out (see Fig. 4).



Figs. 1 and 2.—Marking Out Template for Round Tins

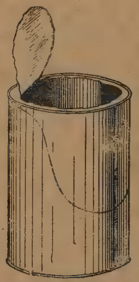


Fig. 3.—Tin Marked from Template

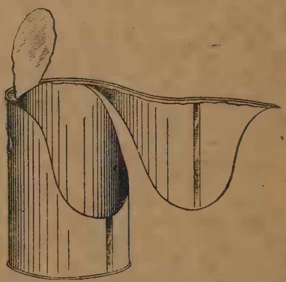


Fig. 4.—Tin Marked and Partly Cut

By leaving the labels on the tins (afterwards removing by soaking in warm water) the pencil marks will be more readily seen when cutting out the scoops.

Overhauling and Grinding a Lawn Mower

THE purpose of this chapter is to enumerate the various failings generally encountered in lawn mowers, to describe in detail the movements most liable to go wrong or give trouble, and fully and graphically illustrate how both the blade and the cylinder can be ground, set, and adjusted in order to get the most effective results without calling in the aid of any special machinery or appliances for carrying out such repairs.

The Elements of a Mower.—The better to understand what follows, first examine Figs. 1 and 2, which show respectively the type of machine under consideration in this chapter, and the same machine dismantled for the purpose of making individual inspection of parts. It might be said that this particular machine has been chosen because it is typical of thousands used by householders who have but a strip of lawn to keep cut, and to whom this chapter might more forcibly appeal. Referring to Fig. 2, the various members are as follows: Nos. 1 and 2 are the side frames, No. 3 the cylinder, No. 4 the front roller and brackets, No. 5 the handle, No. 6 the casting with blade attached, Nos. 7 and 8 the travelling wheels, Nos. 9 and 10 the driving pinions, No. 11 the stay bar, Nos. 12 and 13 the sliding ratchet blades, and No. 14 the washer and split pin.

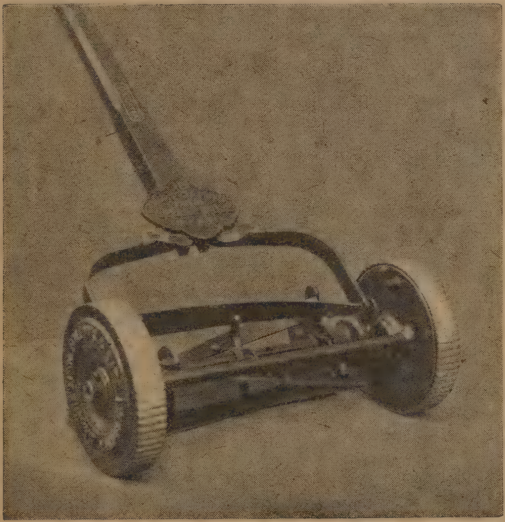


Fig. 1.—Gear-driven Lawn Mower

Removing Dirt and Grease.—In repairing or grinding a lawn mower, first thoroughly rid it of caked soil and grease. Get a bucket of boiling water, to which has been added a generous lump of soda, and with a stiff brush go over all available parts before the process of dismantling takes place. Then when the dirt and grease are removed take off the handle and set the machine on a table or an upturned box, and subject each part that is visible to a close scrutiny, turning the driving wheels and cylinder by hand in order to note the various movements, and also to observe the relative positions of the cylinder and fixed blade. It will most probably be found that the former is set in actual contact with the latter, the owner having adopted this measure under an erroneous impression that it would cut the better.

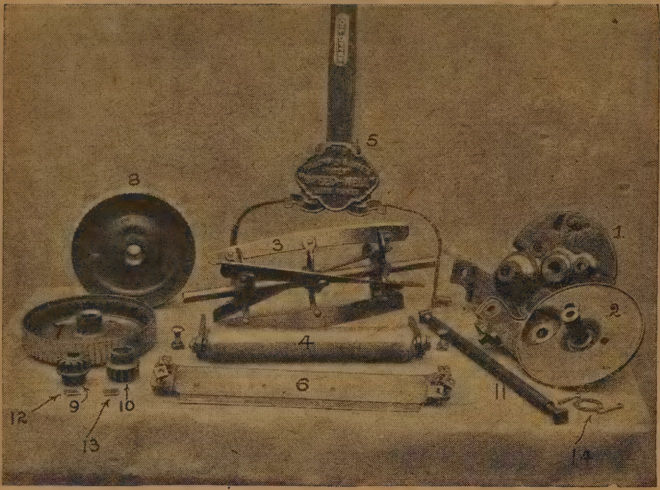


Fig. 2.—Parts of Gear-driven Mower

Taking Mower to Pieces. — Having gleaned what information is permissible by external observation, proceed to take the machine to pieces, first removing the split cotters holding the driving wheels to the frame axles. With the driving wheels will also come away the small pinions attached to the cylinder spindle, and this is a matter which will require more than passing attention.

Sliding Ratchet Blades.—The pinions referred to, in addition to the actual transmission of motion derived through the annular teeth on the inside of the two travelling wheels, also comprise the ratchet movements for permitting the machine to run idle on the back stroke. This is accomplished by means of sliding ratchet blades working within slots at each end of the cylinder spindle. In Fig. 3 one of these pinions is shown at the right of the illustration, the ratchet steps in the pinion and the sliding ratchet blade being also shown. This is an important feature of a mower, and one that is liable to give trouble owing to the wear of the ratchet blade.

Fig. 4 gives a plan of the two pinions used at each end of the cylinder spindle. It will be noted that the ratchet teeth are right- and left-handed; that marked "left-hand drive" going on the left side of the machine looking from the handle end, the other on the right. The cylinder shaft is shown in section, the sliding ratchet blade engaging with one of the teeth. Now if the pinion be revolved in the direction B to A, it follows that the spindle is carried round with it. But if the movement of the pinion be reversed, as from D to C, the sliding blade is pushed back central with the shaft, until the

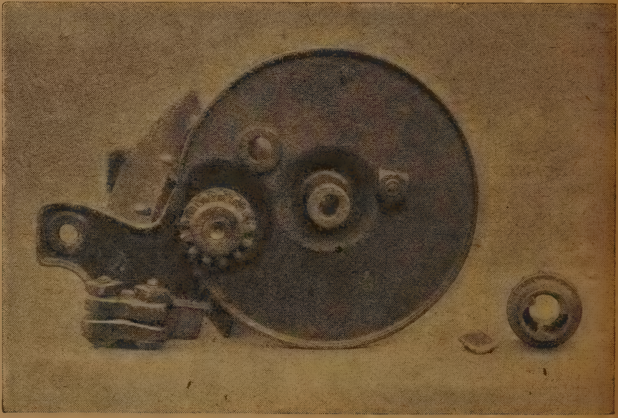


Fig. 3.—One Side of Frame, Showing Pinion and Fixed-blade Casting

opposite tooth engages with it and slides it out of gear in the opposite direction. This is made clear in the second or "right-hand drive" view, which not only shows the reversed ratchet teeth, but also the sliding movement of the blade. Here the rotary movement of the pinion E to F is the driving direction, G to H the idle or disengaging.

In a machine that has been much worn it is usual to find the sliding blade somewhat shortened, hence it cannot engage sufficiently to ensure a positive drive. The remedy then is to make (or buy) new ones, testing their length in situ. They should be made of steel, and case-hardened at the ends. Having removed the cylinder from the side frames, next examine the fit of the spindle ends in the bearings. In this case the bearings are non-adjustable—that is to say, they will not permit of being set together. The fit of the spindle in the bearings is another important feature, since any appreciable shake therein prevents the cylinder being set finely and accurately to the fixed cutting blade; consequently the act of cutting pushes the cylinder away from the blade to the limit of such wear. If this wear is more than a negligible quantity the bearings should be drilled out and brass tube or bushes inserted, the bore being an exact fit to the spindle.

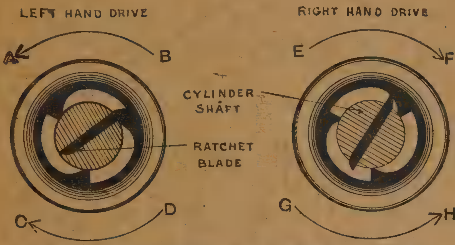


Fig. 4.—Explanatory Diagram of Lawn Mower Ratchet Movements

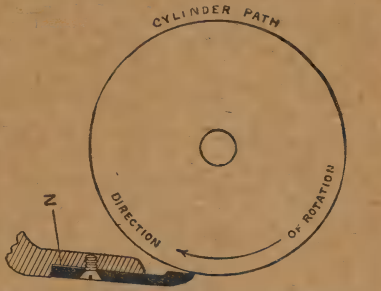


Fig. 6.—Method of Altering Inclination of Blade

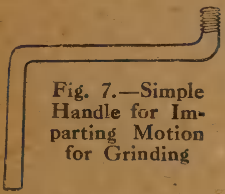


Fig. 7.—Simple Handle for Imparting Motion for Grinding

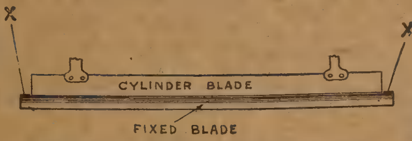


Fig. 5.—Showing Wear and High Places at Each End of Blade

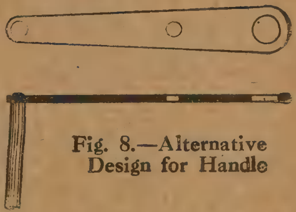


Fig. 8.—Alternative Design for Handle

The Cylinder and the Fixed Blade.—The cylinder now needs attention. It is customary to find the cutting edges of the blades perhaps chipped, or, at any rate, much dulled or blunted. If these are very bad it will mean hours of hand grinding to get them into cutting condition again; and it will pay to have them ground on a cylindrical grinder, should there be a shop within reach in possession of such a machine. The grinding will cost very little. But if no such means are at hand, then there is nothing else for it but to resort to the hand method of grinding.

Continuing the examination of the cutting members, the fixed blade now demands attention. In most lawn mowers this blade is a trifle longer than the revolving cylinder, the consequence being that the two extreme ends of the former are not subjected to wear, and will be found to be higher than the worn portion.

This is clearly indicated in Fig. 5, the high, unworn portions being indicated at x. Now it is evident that any further grinding of the cylinder to the blade will accentuate this difference, and in the event of much lateral movement axially of the cylinder, the tendency will be for the latter to come in contact with the high edges of the fixed blade, and so prevent accurate and close adjustment, as well as providing a source of knock when the machine is at work. These high places on the blade must first be removed before the actual grinding operation begins. As the blade will be found to be hardened, this can be done, not with a file, but on a grindstone, bringing the high places, if anything, a little below the cutting line of the blade.

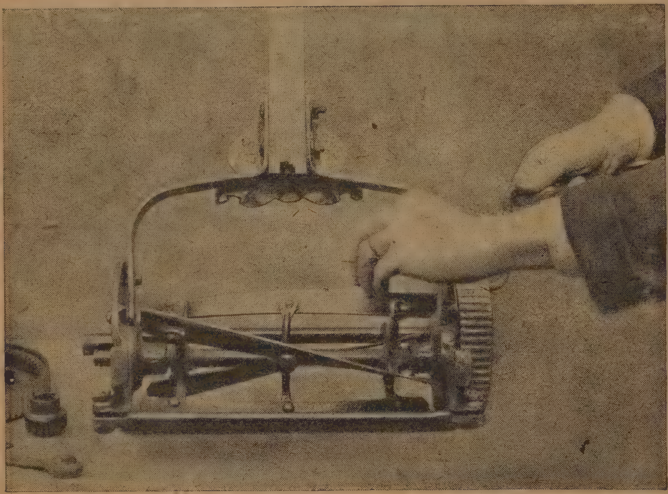


Fig. 9.—Mower Partly Assembled for Grinding

On machines of a larger and more expensive type than the one illustrated, the fixed blade is shaped in section as in Fig. 6, attached to the frame casting with countersunk screws. When it is found necessary to alter the inclination of this blade in order to get the correct cutting angle as shown, this may be effected by slackening the screws holding the blade to the casting, and interposing a layer or two of brown paper where indicated by z, then tightening up again. This cutting angle and its relation to the path of the cylinder being rather important, warrants this attention.

Partial Re-assembling.—Having the cylinder shaft bearing in good order, the ratchet movements correct, and the blade ends ground back, partial re-assembling may be done in order to get on with the grinding. The object of this process is to renew the cutting edges of both the cylinder and the fixed blade. The machine partly assembled, as in Fig. 9, should be mounted on a table or box in the position shown, both the blade and cylinder being free of the support and the latter permitted to revolve. The handle should be elevated and held back against a wall, whilst the front of the machine might be held rigid by passing a short rod through the front roller holes and depending therefrom a weight. But if the latter device be adopted, care must be taken that the frame of the machine has an even bearing on the table, otherwise twist or distortion may occur, with the inevitable result that when the weight is released and the grinding finished, the frame in regaining its normal tension will alter the relative positions of the cylinder and blade, hence trouble in accurate setting.

To work right-handed when grinding, as indicated in Fig. 9, and in order to revolve the cylinder in the opposite direction to that which it takes when in work—this being necessary for the purpose in hand—the ratchet pinions will need temporarily changing. That is to say, the one having its place to the right of the machine will have to be used on the left. Slip this on the shaft, then put on the driving wheel, securing it by means of the washer and split pin. In most machines of this type will be found in one of the driving wheels a tapped hole, into which may be screwed a handle for imparting the rotary motion. This, for simplicity and cheapness, may take the form of that shown by Fig. 7, which is simply a piece of $\frac{3}{8}$-in. iron rod screwed and bent, being about 4 in. in the throw and the same length in the handle. An alternative handle is also shown by Fig. 8, this being made of $\frac{1}{4}$-in. flat iron, swelled out with a hole at the end to slip over the driving-wheel shaft, and held to the wheel itself by a set-pin through the handle and into the hole provided.

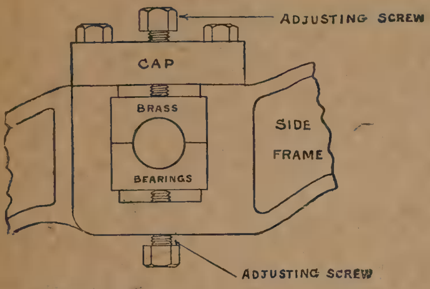


Fig. 10.—Method of Setting Cylinder to Blade in Large Mowers

Next adjust the blade to the cylinder. By referring to Fig. 3 it will be seen that the fixed-blade casting is separate from the side-frame casting, being held thereto with four bolts, two on each side. The under-side of the blade casting, it will be noted, is not flat, but curved, only meeting its fellow at the middle. The purpose of this is for adjustment; that is to say, for setting the blade to the cylinder. By tightening a bolt on each side, the others being slackened, brings the blade either away from or towards the cylinder. The setting of this blade must be a particular detail before grinding is proceeded with. It must be so adjusted that it is in perfect alignment with the cylinder blade throughout its entire length; not in actual contact, but just missing. In machines of a larger type, this adjustment is frequently made by setting the cylinder to the blade, and not, as in the present example, the blade to the cylinder. This is done by means of two set-screws so arranged to lift or depress the bearings set in guides formed in the side frames of the machine. This method is shown in Fig. 10.

Grinding.—The material generally used for grinding is powdered emery, No. 60 grade being a useful and speedy cutting size. This can be obtained from an ironmonger at about 6d. per pound. Having the machine set ready, revolve the cylinder, and from an oil feeder liberally swamp both the former and the fixed blade. Then sprinkle the emery down through the revolving blades, letting it drop just where it will be caught up from the fixed blade by the cylinder. Sound must be the surest guide for the operator to ascertain when the two surfaces are being cut—sound and feel. Also, these senses must provide the knowledge how and when to add more emery. It is best at all times to be used sparingly, and sprinkled from between the fingers and thumb, as shown in Fig. 9. Use plenty of oil, for this flowing down the blade and cylinder will assist in carrying the emery down to where it is required to

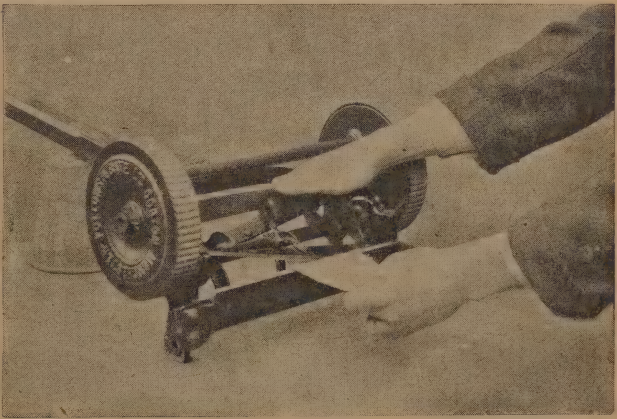


Fig. 11.—Method of Testing Cylinder and Blade for Cutting

do its work. Any cheap oil will do, provided it is of the right consistency—not too thin.

When it is found that the machine works easier, and the noise due to the cutting grows less, it is proof that the blade requires further setting towards the cylinder. A quarter of a turn of a nut—one slackened, the other tightened—will affect this. After perhaps an hour's grinding and several settings it will be advisable to make a test as to its cutting efficiency. To do this, remove from the machine all traces of emery and oil; a dose of paraffin will do this. Then turn the machine upside down, and test the cutting edges with a piece of newspaper held as shown in Fig. 11. If it cuts it cleanly as would a pair of scissors, then it may be concluded that the edges of both blade and cylinder are sufficiently keen to deal with a lawn; but if the cylinder drags the paper in without cutting it, when the blade is set as close as it will go without actual touching, further grinding is necessary.

After the grinding is over the machine will require a thorough washing, for if any of the emery is left to get passed round with the cylinder, or to creep into the bearings, much mischief may be wrought. It will be advisable to give the machine a douche of hot soda-water, after which dry thoroughly, and then smear a little clean oil both over the cylinder and the blade. The remaining parts may now be assembled, the front roller adjusted to the height desired, the handle fixed in position, and the bearings well oiled.

Some Precautions.—In setting up a lawn mower after repairs, in addition to the care exercised in seeing that no abrasive material is left about the machine, due attention must be paid to both alignment and its smooth and easy running. The side frames being independent of one another, and relying wholly on their connection with the blade casting and the round stay rod at the back, it is essential to see that these members are not only tightened up securely, but without twist. The cylinder should be quite free; in fact, so free as to admit of its being spun several revolutions by hand before it comes to rest. And here again the ratchet movements must be carefully watched. If renewed, a sliding blade a shade too long may cause rubbing in the pinion teeth path, and induce stiffness throughout the whole machine.

Another precaution to be faithfully observed when applying the paper test to the cylinder is to test the whole length of the latter, not relying only on its cutting perhaps at one end or in the middle, as the case may be. And do not permit the cylinder to touch the blade at any point. Unlike the action of a pair of scissors, where the cutting blades rub along one another, the principles of a mower are such that the act of cutting should be perfect only when the cylinder is just missing the blade by the merest fraction. Good oil, which is not too thin, or yet will not become gummed, is indispensable to a mower, and it is a distinct advantage, if at all possible, to keep small wood plugs in exposed oil holes in order to prevent dirt entering the bearings.

Having finished using a mower, it is an excellent plan to first remove from the cylinder and blades all moisture adhering thereto, and then to smear a little oil or grease over the cutting edges before putting the machine away.

House Painting

THIS chapter carries a stage further the work described on pp. 29 to 37 of this volume.

Preparing Woodwork for Re-painting.—The painted woodwork is here assumed to be in fair condition; badly-blistered surfaces will be dealt with on a later page. In a pailful of moderately hot water, dissolve a packet of Hudson's powder, or use sugar soap sold by paint dealers. Use the black washing-off brush and several pieces of light, not heavy, pumicestone, or a coarse "patent" pumice block (such blocks are obtainable in a number of different grades). The light pumicestone cuts or rubs down better than the heavy samples; cut it to shape with an old saw, and rub smooth on a piece of York stone.

Now wet the door and frame all over, at the same time scrubbing the mouldings with the brush, and removing the dust from the top edge of the door. Dip the pumicestone into the water, and then rub the paint with a circular motion, which will smooth the surface and assist the soapy water to remove the greasy, smoky film. When the pumicestone becomes clogged, rub it down from time to time on a piece of York stone, or face to face with another piece of pumice. The door, immediately after washing, must be rinsed with clean water, taking care that none of the soapy water remains in the quirks of the mouldings.

Treat the window in the same way, not forgetting the runners and other places likely to be missed when people are in a hurry. Lastly, look to the skirting.

Rubbing is at once the most necessary and the most disagreeable part of painter's work. Unless all smoke and grease are removed, the subsequent paint will not dry, and, even if it did, the smoke would gradually work its way through. By grease is not meant absolute fat, but that left by the frequent contact of the hand, which is quite sufficient to prevent the proper drying of oil paint.

To assist the washed work to dry, open all the windows and doors, or, if the weather is wet, light a fire.

Discolorations and Knots.—It has been assumed that the paint, after having been rubbed down, was in fair condition, that is, it was not blistered or discoloured through the exuding of turpentine or gum from the knots; but should these troubles be present, they must be remedied before any painting is done, or failure will result. The presence of only one knot, improperly treated, will spoil the appearance of a door, especially if finished white or in a delicate tint. Where the old paint is simply discoloured through the presence of knots or turps, but otherwise sound, it is sufficient to brush these places over with white patent knotting. The spirit in knotting readily evaporates, leaving the material thick and unworkable, and for this reason the bottle should be kept well corked. If the knotting is in frequent use, the hog-hair fitch or brush that is used should have its handle thrust through the cork, so that the bristles are constantly immersed in the liquid, while the bottle itself is air-tight. If required but temporarily, the brush, after use, may be cleaned by rinsing in methylated spirit, and washing with soap and water.

Supposing the resin has exuded from the knots and caused the paint over them to crack, they must be bared by scraping with a suitable knife, and then coated twice with the knotting. When knots project slightly above the surface, defying all ordinary attempts at hiding them, they should be sunk slightly below the surface with a carpenter's gouge, knotted, and filled up in the subsequent painting.

Removing Old Paint.—In cases where, at different periods, many coats of paint have been applied one over the other the paint film becomes brittle and chips off at a slight knock or blow. In such cases the only satisfactory way of producing permanent results is to clean the lot off and begin afresh. Even if the old paint be re-coated, as, unfortunately, is frequently done, the result will not be successful, as the paint will begin chipping at the earliest provocation.

There are several ways of removing paint, the oldest, and in some cases the safest, being to burn it off with a blow-lamp. Where paint is removed with the lamp there is always the certainty that the surface is quite safe to paint on; the chief drawback to its use, however is the liability to char, or, at least, discolour, the wood. When using a blow-lamp, begin at the bottom of the panel or other surface that is being burnt off, and always move the knife the way of the grain of the wood. Follow the lamp with the broad knife, or with a chisel knife, or, if working on mouldings, with the shave hook (Fig. 55), taking care not to dig the tool into the wood. The surface will need well rubbing down subsequently with No. 1½ to 2 glass-paper until quite smooth. The glasspaper may be doubled round a flat piece of cork 4 in. by 3 in. by 1 in., so forming a block for the broad surfaces. Be careful not to inhale the small particles of paint, a remark which applies to rubbing down paint at all stages. The work having been rubbed down, the knots must be treated as previously advised.

Among the many methods of removing paint may be mentioned the use of alkalis, such as a mixture of pearlash and soda, or potash and lime, made into a paste and spread on the paint with an old brush, and left on until the paint shows signs of yielding. But these mixtures are messy, and, without special care, will burn the hands or discolour the nails, and therefore are not recommended. They will, however, remove the paint; if used the surface should be afterwards well rinsed with cold water, and when dry brushed over with common vinegar. This is done to neutralise the action of any alkali that may, despite the rinsing, remain in the wood.

There are on the market quite a number of paint and varnish removers which may be relied on to answer their purpose. Most, but not all, of them are of a volatile nature and inflammable. Instructions for using are supplied with each, and should be carefully followed. Removers that are of a volatile nature do their work more quickly and thoroughly if, after the paint has been treated, it is temporarily covered with an old dust sheet, or even newspaper. Egyptian clay, though of a different nature, is another good paint solvent.

After the paint has been removed, the woodwork must be left until there is no doubt about its being dry, because moisture under oil paint is one of the fruitful causes of blistering and peeling. The woodwork should next be well rubbed down, and all knots properly coated, the work being now ready to receive the first or priming coat of paint. The work may now be regarded as new wood, the same method being adopted for each.

Brushes.—It will be necessary to have an outfit of paint brushes, the number being regulated by the amount of work contemplated. A No. 6 sash tool, a bevelled sash tool, and a No. 6 oval paint brush are practically indispensable. The advantage of buying ground brushes is that they are partly broken for work, while the other kind of brushes require a fair amount of use before they reach their best condition. A good and quick method of breaking a brush in, where practicable, is to use it on a rough surface for a day, such as a brick or cement wall.

Brushes are tied up ("bridled") to reduce the working length of the bristles, part of the bridle being removed as required to compensate for the shortening caused by wear.

Fig. 1 illustrates a simple method of bridling a brush. Take a piece of medium thick twine or cord, such as bricklayers use for their line, and, looping it as indicated, wind round until nearly one-third of the brush is covered. Finish with a half-hitch, and slip the cord through the loop on the one side, and if passed under the bottom ring on the other it will be neater. Then pull the two ends tight and fix with short tacks, as shown in Fig. 2. If the cord is inclined to twist and gather into knots during the operation, begin again; but first dip the cord in water for a few minutes, when the slight dampness will make the process of bridling easier. Never bridle a brush too tight, as shown in Fig. 3, as it not only spoils the brush, but prevents getting full value out of it during use.

The sash tool may be tied up in similar fashion; but instead of using tacks the handle of the brush may be slightly slit each side with a penknife, the twine pressed into the slots, and the ends cut off clean.

A brush not properly looked after will go crooked and twisted, especially if of inferior quality. The standing of brushes in a paint can of water so that they rest on the bottom helps to twist them. They should always be *suspended* in water, so that when taken out they not only have their proper shape preserved, but are free from grit or dirt which may have collected at the bottom of the utensil. The water should reach up to the string, but not over the stock. Mitchell's patent diving-bell brush-holder has proved excellent for storing brushes; but failing this a hole should be bored through the handles and wire or cord thrust through. Brushes that are not required for a considerable time should be rinsed out in turpentine, washed with soap and water (not with soda), hung up till dry, and then laid aside in a cool dry place. Brushes set in tin must on no account be immersed in water over the bristles or up to the tin, or they will be ruined. These brushes are best stored in linseed oil or a mixture of oil and turpentine.

The amateur is often tempted to buy cheap and very inferior brushes; but the fallacy that good brushes or brushes in good condition are unnecessary should be banished. It is impossible to do high-class work with unsuitable tools. The right sort and quality of brush is the cheapest in the end, as it will not only outlast two inferior ones, but it possesses a spring that is missing in the others. Moreover, the bristles cling together in a good brush, and enable the work to be laid off without unsightly lines or brush marks.

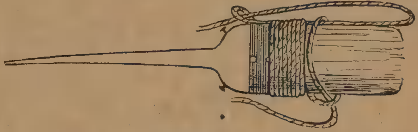


Fig. 1.—Bridling a Paint Brush

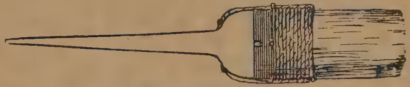


Fig. 2.—Brush Bridled for Use

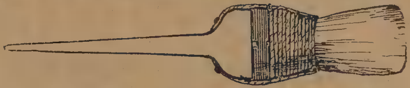


Fig. 3.—Brush Bridled too Tightly

Where the cost is a consideration, the varnish brush may be made to answer the purpose of the paint brush, and vice versa; but when changing over a brush from paint to varnish, the preliminary cleansing must be thorough, as otherwise any paint left in the stock of the brush may work down into the varnish, and leave coloured streaks on what should be a colourless surface or film.

Cleaning Paint off Glass.—To remove painted signs, etc., from the fixed panes in windows and doors (work, however, that scarcely comes into the job now being considered), mix together a thin paste of ordinary flour and water, boil it, and then add concentrated lye sufficient to cause the mixture to be of the consistency of ordinary paste. Apply and remove several coatings, allowing about a quarter of an hour between each application; scrape off with a scraper or ordinary putty knife. Then sponge the glass and rub with whiting and water. When this is sponged off, chamois and polish with a piece of clean linen or tissue paper. If the glass is loose (unmounted), provide a bath of strong lye solution in some suitable receptacle, preferably of earthenware, in which the glass can be stood up on edge. Allow the glass to stand in this solution until the paint is destroyed; when removed, rinse in clear water and wipe dry with sawdust. Rub with dilute ammonia and whiting, dry again with sawdust, and finish by polishing as above directed. The lye referred to may consist of a solution of 2 oz. soft soap and 4 oz. of potash in just sufficient boiling water to dissolve them, 8 oz. of quicklime being afterwards added; or equal quantities of soda and quicklime could also be used with the same effect.

THE INGREDIENTS OF OIL PAINT

Ordinary oil paint contains a *base*, consisting of white-lead, zinc-white, or red-lead; a *binder* and *vehicle*, generally linseed oil; a *thinner*, generally turpentine; possibly a *drier;* and frequently a *pigment* in addition to the base. The base, itself a pigment, gives body to the paint and protects the surface treated; the vehicle allows of the easy application of the base and gives a further protection; the thinner makes the paint workable; the drier assists the paint to "dry" (actually to oxidise, since the "drying" of oil paint is not an evaporative process); and the pigment imparts colour and frequently body as well.

White-lead.—For the amateur there is no pigment easier to use than good white-lead, and, allowing all the virtues claimed for zinc oxide, it is an open question whether the latter surpasses white-lead for under-coats. The very best white-lead should always be bought, and the easiest way to ensure getting the proper article is to purchase from a firm of repute. There are several methods of testing white-lead to see if it contains adulterants or reducers; but for practical purposes there is nothing better than rubbing a little of the lead in equal parts of linseed oil and turpentine, and coating a piece of glass and a piece of black-painted board. Hold the glass up to the light to test the fineness of the particles, remembering that a finely ground paint is usually a good covering paint. Test on the blackboard for opacity or hiding qualities. If these tests are made side by side with a sample of white-lead of known quality, the worker will be fairly well able to judge as to whether his purchase is up to the standard of quality desired for the job in hand. Of course, for ordinary painting paste white-lead and not dry white-lead is used.

Driers.—Driers may be paste, known as patent driers, or terebine, frequently called liquid driers. The same thing applies to these as to the lead; they should be bought from a reliable source.

Oil and Turpentine.—The vehicle and thinner required are raw linseed oil and turpentine, or a reliable turpentine substitute.

Making the Paint.—The durability of paint depends to a large extent on its possessing the right amount of elasticity in each coat. To mix a paint and apply it as mixed for every one of the four coats is not the way to get a surface that will withstand heat and resist hard usage.

It is supposed that a room is to be painted ivory white, leaving a surface possessing a semi or egg-shell gloss. Take, for instance, the room mentioned on p. 29. If the paint is cleaned off to the wood, a different method must be adopted from what would be the case if the painted work were simply rubbed down.

Take the white-lead; if it has been covered with water, beat this out before adding anything to it. The presence of water in the paint is likely to lead to subsequent blistering. Take 6 lb. of white-lead, 5 oz. of patent driers or five tablespoonfuls of liquid driers; if the weather be hot use slightly less, if wet or cold a little more. Add linseed oil, and beat up the lead with a flat stick or spatula, making it as smooth as possible. For bare wood take dry red-lead, and grind a little in oil with the palette knife on a slab of marble or piece of glass. Pour part of the thick mixed lead into the strainer, enough to first coat the room, add to this the red-lead, and gently force through the strainer with an old stump—that is, a well-worn brush. If too thick to go through, add a little more oil, finally rinsing the strainer round with a little turpentine.

The paint when strained should be of a faint pink tint, but it will be too thick for use. For a first coat it should be fairly thin, the thinners being 2 parts oil to 1 part turpentine.

PLAIN PAINTING INDOORS

How to do Plain Painting.—Apparently, the commonly accepted theory is that anyone, without either thought or care, can do ordinary plain painting. There certainly is nothing very difficult about the general run of it; but at the same time, without a knowledge of the rules governing paint and its application, failure rather than success is likely to accrue.

Again, the number of prepared paints is legion, many being good, some indifferent; but for the ordinary worker there should be no paint better than that made for the particular work in hand. The prepared paints, many of them, are excellent in the hands of a skilled man; but to try to cover iron or slate, or any other dark surface, with a glossy enamel in one coat is to court disaster. There may be full instructions on the tin; the amateur, however, ignoring these, frequently applies a very thick coat of the paint in a vain endeavour to make the surface appear solid, with the result that it runs down in tears, presenting a sickly, unsightly mess.

Painting a Room: First Coat.—When painting, say, the door, begin on the mouldings in one of the panels, working the colour well into the quirks, using the sash tool for the purpose; then the panel itself, being careful to lay the paint off straight the way of the grain of the wood. In laying or finishing off use the brush lightly, so as not to leave coarse ribs or brush marks. This applies with even greater force to subsequent coats. Paint the panels, then the muntins, next the rails, and finally the stiles.

When "cutting in" sashes the chief trouble will be in keeping the paint off the glass. A large fitch or No. 4 sash tool, especially if well broken in, is the most useful for painting sashes. Do not draw the brush after, but push, as it were, the bristles before you; by this method there will be most likelihood of cutting the paint in clean and straight. Draw or push the tool from top to bottom of each bar, repeating the process until the wood is covered. Do not be sparing with the paint in this instance, and especially do not lift the brush at every few inches, or every setting in will be evident by a blob or an irregular line on the glass. Spots of paint that may get on the glass should be wiped off at once with a piece of clean rag before they have a chance to dry.

Paint the skirting last. If this is done first there is always a possibility of picking up dirt with the brush, which would subsequently be left on prominent parts of the door. If it is difficult to cut in clean to the floor, take a sheet of newspaper, and if the skirting has shrunk from the floor push the paper into the opening and paint down to it; if impossible to push under, keep the paper close to the skirting. A piece of thin zinc or sheet-tin may be more serviceable.

The reason for adding red-lead to the first coat is to assist the drying and hardening of the paint, and at the same time to prevent undue subsequent suction or absorption. It is for the same reason that oil predominates in the initial coat.

Using Stopping.—Make up stopping with 2 parts of common putty and 1 part of paste white-lead, and if too soft, powder some good dry whiting and work this well into it. Putty is frequently adulterated, but the best should be made from whiting and raw linseed oil. The painter could make his own, though it is generally more serviceable if made and allowed to stand in bulk for several months, and therefore it is generally preferable to purchase it.

Allow the paint to get hard, which should be accomplished by the following day; then rub down with No. 1 glasspaper, always the way of the grain. Dust off, and with the putty on a board, not in the palm of the hand, especially if white-lead is mixed with it, stop all cracks and holes, well pressing the putty home and facing up all irregular places. When facing up, use both hands to the putty knife, pressing with the fingers of the left hand on the end of the blade. Clean facing up is required, the putty being left only in the indentations and other rough places. Where a great deal of stopping is necessary it is desirable to leave the putty to get hard before applying the next coat of paint, as the brush is likely to rub it out, especially in the shallower places, where, comparatively speaking, it is most required. Allow it, then, to get hard, and previous to painting lightly rub down with a piece of worn glasspaper.

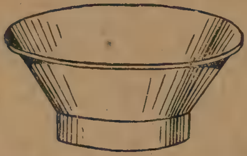


Fig. 4.—Paint Strainer

Second and Third Coats.—The second coat of paint requires to be made with 5 parts of oil and 3 parts of turpentine. Stain to an ivory colour with chrome yellow and a touch of lampblack if a cool tone is required, and with burnt sienna or vermilion for a warm colour. The staining colour should be rubbed up separately on the palette board, and added to the lead before straining. Remember that chrome yellow is a strong stainer, and it is possible without being properly mixed to get a canary instead of an ivory colour. Paint as before, well brushing the colour out, and using it thin enough so as not to leave coarse brush marks. This in turn should be rubbed down, and the third coat made with equal quantities of oil and turpentine.

Fourth and Final Coat.—The final coat should be 2 parts of turpentine to 1 part of oil; the addition of a little good mixing varnish will help to prevent the paint drying "sheary"—that is, in alternate dull and glossy streaks. Try the paint on a little exposed part, and if it does not dry with an equal semi-gloss add a little more varnish. Good quality oak varnish will do if mixing varnish is not handy.

It should be noted that if the last coat but one is stained slightly deeper than the last, the paint will sink and present a better appearance than if the colour is exactly alike. If the final coat is made from zinc oxide the paint will keep its colour better; but the amateur is recommended to finish with white-lead.

Two-coat Work.—Coming now to painted work simply rubbed down, which it is desired to finish in two coats, carefully touch up any bad or bare places with thin paint before applying the first coat. If bad places are to be found on a door in a prominent position, it may be more satisfactory to give the entire door an extra coat.

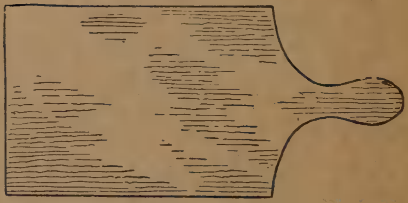


Fig. 5.—Palette Board

The woodwork, if fairly glossy, should be painted first with paint made with 3 parts of turpentine and 1 part of oil; for the second coat use 2 parts of turpentine and 1 part of oil. If the woodwork is in dead or flat colour, the first coat should be 5 parts of oil and 3 parts of turpentine.

Paint-can, Strainer, Palette Board, etc.—The paint-can (see Fig. 56, p. 35) may be of either zinc or galvanised iron. Fig. 4 shows an ordinary strainer requiring muslin or other material tied on the bottom part. A collapsible strainer may be purchased, but the one illustrated should be sufficient. Fig. 5 illustrates a palette board, a convenient size being 15 in. by 11 in. by $\frac{3}{8}$ in. This may be of pine, pearwood, or mahogany, and is useful for grinding small quantities of stainers, or for working from when tinting cornices. A similarly-shaped board should be used for putty made from white-lead or other poisonous pigment. It is unwise to hold such putty in the bare hand, as there is a possibility of scraping the particles into the pores of the skin; besides, the use of a putty board 5 in. by 3 in. by $\frac{1}{4}$ in. is more workmanlike.

PLAIN PAINTING OUT-OF-DOORS

It is doubtful whether the amateur painter gives much thought to the preservation of the structure, the only consideration being its appearance. In painting, however, the first end is gained by attending to the last. The brightening of outhouses and garden appliances is a simple matter if gone about in the right way. It is the purchase of that tin of paint of uncertain quality and drying power that is the cause of so much annoyance and dissatisfaction, the paint which seems to attract all the dust and fibre within the square mile, until the user is disgusted with paint and painting.

The amateur tries to do too much with little trouble. An extra bit of painstaking makes all the difference, and brings satisfaction.

If paint is bought ready-mixed, it is important that it should not have been long in stock, as it then works badly. It will be found more satisfactory to buy a little colour ground stiff in oil, and mix this as required. For white paint, white-lead may be bought by the pound at oil-shops; but this has often been left uncovered, so that it has become hard and unworkable. Seven-pound and 14-lb. tins can be had from colour firms, and this may be depended on to be in good condition.

Supposing the painting work contemplated is to be finished part in white and part green, the materials required are paste white-lead, paste driers, paste middle brunswick green, dry or paste vegetable black, raw linseed oil, turpentine, a little boiled linseed oil, and outside oak varnish.

When mixing white-lead add 1 oz. of paste patent driers to each pound of lead. Mix stiff in linseed oil, using a flat piece of wood made like a spatula to break up the white-lead. This may be done in one of the paint-cans or in any wide-mouthed earthenware jar. Tie a piece of canvas or other strainer over another vessel, and strain the white paint, helping it through by brushing it about with one of the fitches; any old stump of a brush is useful for this purpose.

To make a good job it will be best to give the woodwork at least two coats. Take, therefore, half of the strained white-lead, and thin this down to a working consistency with 2 parts turpentine and 1 part linseed oil. The remainder intended for the second coat leave thick until required, when it should be thinned with 3 parts of oil and 1 part of turpentine.

If the woodwork to be painted is an outhouse or a fence, and it appears very smoky and dirty, wash down with a pail of water in which a packet of soap-powder has been dissolved. An old two-knot whitewash brush which has been worn to a stump is excellent for this purpose. These old brushes may often be bought, and cost very little. Failing this, a scrubbing brush will answer. Well rinse off the suds with plenty of clean water (as any soap-powder left on will presently attack the paint) and leave the surface to dry before painting. Wherever there is a suspicion of soot on the woodwork the washing is essential, as paint refuses to dry on a smoky surface.

Knots that show badly should have the paint scraped from them, and be brushed over with patent knotting, obtainable in small quantities at any oilshop. Blisters should be cut out, and after the first coat filled up with putty made from equal parts of paste white-lead and ordinary putty. A little good ordinary putty may be made by powdering dry whiting, and making it into a dough by adding raw linseed oil. A painter's stopping knife (Fig. 58, p. 35) will be useful for stopping holes and facing up bad places with the putty; but an old, well-worn table knife will answer.

Fences and other less important woodwork need not be rubbed down; but doors could be rubbed smooth while they are being washed by using a piece of pumicestone ground smooth on a York stone. Instead, the work, when quite dry, may be rubbed with glasspaper.

The white paint made as directed will dry in about ten hours. Do not give a second coat the following day, however; but leave a day between, so that the paint may get hard.

When applying the paint, do so as evenly as possible. Afterwards, if there is any doubt as to whether the second coat will cover, bad places may be touched up with a little of the first coat, and allowed to dry before the oily coat is applied.

The green paint, also bought stiff in oil, is the next consideration. Middle brunswick green may appear too bright for some purposes; if so, darken it by adding vegetable black in oil; or if the black is bought in a powder, grind some up in linseed oil on a piece of glass or slate. Green pigment of whatever kind has not the same preservative and weather-resisting properties as white-lead. If, therefore, bare wood that is to be finished green is painted direct with the green, the surface will quickly become dull and lustreless owing to the porous nature of the wood. The same thing will happen, only to a less extent, by painting direct on to an existing green. First of all, give a coat of white and black made to a light lead colour, and if on bare wood two coats; on this the green will dry with an even gloss, and be far more durable.

The green paint may be used in the same way as the white, except that a little good outside oak varnish should be added; thus the quantities should read, turpentine 1 part, linseed oil 4 parts, varnish 1 part. Boiled linseed oil of good quality is better than raw linseed for dark colours, and when this is used the varnish may be dispensed with, the quantities being turpentine 1 part, boiled oil 6 parts. In this case reduce the driers by one-half.

Where chocolate is preferred to green, the ground may still be painted a light lead colour, and finished with middle purple-brown bought ground to a paste in oil, and mixed in the same manner as green. If too bright, add a little black. Middle or deep indian red is a good colour, and would also require toning down with black.

The foregoing paints will dry with a fair gloss, and should not be varnished. Where paint is finally varnished, the under-coats should be mixed in a different manner. Take a green outer door. Use lead colour with equal parts of oil and turpentine, green with 1 part oil, 1 part varnish, and 6 parts turpentine. On this give one coat of good outside oak varnish. The paint brush may be used in the varnish, first rinsing out the colour with turpentine and wringing out the spirit that remains in the stock of the brush.

The amateur may, after all, prefer to use a ready-made paint, and if this is done the brand selected should be of a well-known firm. Any thinning for the first coat may be done with turpentine, for the second with oil or varnish.

THE WATER PAINTING OF WALLS

Apart from size distemper paint (for which see earlier pages), there are two chief materials in general employment for painting walls, namely, water or "washable" paint, and oil paint.

"Washable paint" is a water or distemper paint which is capable of being cleaned. Recipes for making washable distemper are given later in this chapter, but it seems inadvisable to attempt its manufacture when so many good proprietary articles are available, these requiring simply the addition of water or the prescribed thinner to be ready for use. Satisfaction is likely to follow the use under suitable conditions of any of the specialities that have stood the test of time. Instructions are supplied with these; but it is to be feared that they are not always strictly followed, and sometimes disappointment ensues.

Because ordinary distemper generally presents a solid appearance in two coats—that is, the clearcole and one coat of distemper—the same result is often expected of the water paint, an expectation that is generally fulfilled when the surface is naturally suitable or has been prepared to receive the paint. When, however, the surface is smoky, discoloured, badly damaged, and of uneven porosity, a perfect result will not follow the application of only two coats.

Water paints on walls are not so much substitutes for ordinary distemper as for oil-painted and flatted work. This should be taken into consideration when comparing the cost of water paint with other materials, the comparison being properly with oil paint, and not with size distemper. Seldom, indeed, can a wall be painted and flatted with less than four coats, whereas "sanitary" or "washable" distemper should give an equal appearance, so far as solidity and refinement is concerned, with three. The water paint cannot, of course, be washed at first, and possibly never, with the same impunity as oil and flat, some taking three weeks or more before they may properly be washed. One feature of water paint is that, like oil paint, it may be coated over without having to be removed down to the plaster, which is the case with size distemper. A simple dusting, or at most a wash down with clean water, should be sufficient preparation for subsequent renovation by the application of further coats of water paint. Water paint gives a suitable ground for working on with oil paint, and if rubbed down with glasspaper doubled round a cork or wood block serves as a filler. It would be necessary in the case of size distemper to remove the whole before painting in oil colour. If, by way of a change, it were desired to paper the walls, the water paint by simply washing would give a suitable surface.

When a papered surface is to be converted into a water-painted one, the paper should be stripped and the walls repaired; but, if there is a doubt as to the condition of the plaster, the paper itself, if sound and not very dirty, presents an excellent ground for distemper, whether washable or ordinary. The joints in the paper must first be rubbed level with glasspaper, or they will show up badly. Clean lining paper hung so as to lap slightly, the joints being afterwards smoothed down, makes one of the most reliable grounds for washable distemper, and is recommended wherever the walls are greatly damaged. Walls hot in nature should have excess suction stopped by means of the liquid thinner recommended with the particular kind of paint used.

The final coat of washable distemper always presents a more refined appearance if it is lightly stippled; while, in the case of Alabastine, fine effects may be obtained by applying the colour fairly thick and stippling it heavily, so as to give a more than usually rough texture.

Some of the water paints may be used on plaster that is only a few weeks old, but not on absolutely new plaster. This is best left uncoated and unpapered until it has had a fair time to get dry, or the colour will not be even in tone.

Washable distemper is especially suitable for bedrooms, where light, simple treatment is desirable, and where, in many respects, it is superior to wallpaper. A frieze in a different colour is advisable, with a stencilled ornament in harmony with the ground. Stencilling may be done with some of the same material, with flatting colour, or, in the case of Alabastine, with white shellac. Washable distemper is suitable also for staircases and kitchens, and where exposed to hard wear the lower part may be treated to form a dado. This is best in a deeper colour; varnish on it will deepen it considerably, but, with regard to some of the specialities, the colour need not be changed if the size specified for the purpose is used.

The chief point to remember when using any of these water paints is to adhere strictly to the printed instructions.

and limit the material to those surfaces for which it is expressly made. Tampering with the article in any way will generally spoil it.

THE OIL PAINTING OF WALLS

There is no question about the durability of oil-painted walls provided the surface is good. They take longer to complete, as at least three and generally four coats of paint are necessary to stop suction and present an even finish ; but once completed, they will withstand a large amount of wear and tear, and bear frequent washing. Bathrooms, kitchens, and pantries will repay for the extra time and expense involved. A painted wall can be easily renovated by washing down with soap and water or decorator's soap, and freshening up with one coat of paint. If the paint has been varnished the washing alone will be sufficient.

To prepare a wall for oil painting it should be clear of paper or ordinary distemper. The presence of a good water paint is no detriment, but often an advantage. For a bare wall, if in good condition, the first coat may consist of lead paint mixed with 2 parts of linseed oil and 1 part turpentine with the necessary driers. If the wall is damaged it should first be repaired with Parian or Keene's cement. Alabastine may be used instead, and for small holes and cracks is recommended, for, though costing more, the paint will bear out better on it. Even the large places might be partially stopped with Keene's cement, and then finished with Alabastine. Lime putty must on no account be used for repairing a wall for oil plant, as the lime will saponify the oil in the paint, and prevent either proper adhesion or drying. It is for this reason that newly plastered walls should not be painted, but, after being allowed a proper time to dry, be coated with ordinary distemper or washable water paint.

There may be a temptation to paint direct on to ordinary size distemper, but this should be resisted, as the whiting will absorb the liquid in the paint, and later the paint may chip at a blow, and leave the wall, bringing away the distemper with it.

Any facing up required should be done on the first coat of paint previous to glasspapering. This may be done with Alabastine used thin, or with dry whiting 1 part and paste white-lead 2 parts mixed to the consistency of cream with pale japanners' gold-size and a little turpentine. This should be spread on with the broad knife, and immediately scraped as clean as possible, so that the stopping remains only in the rough or uneven parts ; hold the knife firmly with one hand, pressing the point with the other, and bring down as far as possible in one stroke. Allow the stopping to get hard, which should take at least a day ; and rub down with fine glasspaper doubled over a flat piece of cork. Then give a second coat of paint containing slightly more turpentine than the previous coat. The third coat may have equal parts of oil and turpentine, and the finishing one less oil but with the addition of a little mixing varnish, so as to assist in making the wall dry with an egg-shell gloss. It is advisable to stipple the last coat, as the slight texture given by the stippler will be more pleasing than the lines left by the paint brush, however straight and clean the paint is laid off. When painting walls, keep the paint fairly thin and brush it out well.

The list of tints given later includes the pigments employed to produce them. Resembling the lists on pp. 36 and 37 in many particulars, it will, nevertheless, be advisable to consider them separately, since some pigments (Dutch pink, for instance) suitable for distemper are not ideal for oil paint. Moreover, without entering into the technology of paints, there are some pigments which should not be used, that is, mixed together, as one destroys the other. Blue and yellow, of course, produce green, but ultramarine and chrome yellow will not make a true green, since ultramarine inclines to purple in tone, and, if mixed with yellow chrome, which has a lead base, the sulphur in the blue in combination with the lead in the chrome sets up a chemical reaction, which would in time destroy the colour. There are chromes with a zinc base; but even with them to produce a green the proper blue would be prussian blue. There are other combinations that are inadvisable for the same or some other reason; but if the following colours are employed to make the tints required, the result will be satisfactory provided the pigments are of good manufacture.

Apricot.—Yellow chrome, vermilion, and crimson lake; for a tint add white. *Apple green.*—Chrome green and white; a commoner colour may be made from middle brunswick. *Bronze green.*—Prussian blue, lemon chrome, and burnt sienna; middle brunswick green and burnt umber; or deep chrome and black. *Olive green.*—Chrome yellow, burnt umber, and blue-black; or chrome yellow, prussian blue, and burnt umber. *Sage green.*—White, yellow ochre, prussian blue and black. *Pea green.*—White and chrome green; or white and light brunswick green. *Duck-egg-green.*—White, cobalt blue (or prussian blue), and chrome. *Eau de nil.*—White, lemon chrome, emerald green, and prussian blue. *Cream.*—White and middle chrome. *Coral.*—White, vermilion, and chrome yellow. *Drab.*—White and burnt umber. *Fawn.*—White, raw sienna, and raw umber. *Flesh colour.*—White and venetian red; or add a little orange chrome. *French grey.*—White cobalt blue, and venetian red; or zinc oxide, ultramarine, and venetian red. *Heliotrope.*—Zinc oxide, vermilion, and ultramarine. *Ivory.*—White and middle chrome. *Lavender.*—Zinc white, ultramarine, and carmine. *Leather.*—White, yellow ochre, venetian red, and black. *Salmon.*—White, burnt sienna, and yellow ochre. *Old gold.*—White, middle chrome, and burnt sienna. *Peacock blue.*—White and cobalt blue; or white, ultramarine, and emerald green. *Peach.* — White, vermilion, lemon chrome, and crimson lake. *Rose.*—White and carmine. *Stone.*—White, yellow ochre, and burnt umber. *Straw.* — White and middle chrome. *Terracotta.* — White and burnt sienna. *Turquoise blue.*—White, cobalt blue, and emerald green. *Tuscan red.*—Indian red and rose pink. *Violet.*—White (zinc oxide), ultramarine, and crimson lake. *Wedgwood blue.*—Ultramarine, zinc oxide, vermilion, and middle chrome. *Wedgwood green.* — White, prussian blue, lemon chrome, and vermilion.

In mixing colours or tints, the prevailing tone should be the base on which stainers are ground; but in every case experiment should be made with small quantities. The colours named are only a few of very many, and these can be made from pigments other than those named. Care must be taken not to use raw umber when burnt umber is obviously the proper pigment, nor raw sienna when burnt sienna should be employed. The same thing applies to the chromes, which range in shades from lemon to deep orange. Thus it will be seen that orange chrome is not suitable to mix with prussian blue to make a cool green.

WASHABLE DISTEMPER PAINTS

As already recommended, washable distemper powder is best bought ready made, there being a number of reliable brands on the market. The reader intent on making his own may be informed that casein (a milk product) is the binding agent often employed, this being incorporated with an alkali and a suitable base, such as whiting, china clay, etc. The process is first to add, say, from 15 to 20 per cent. of sodium carbonate or 25 per cent. of ammonia or borax to the casein to neutralise its acidity and render it soluble in water. The casein, alkali and water are heated together, the temperature not exceeding about 155° F., and, when the solution becomes homogeneous, the white base, in the proportion of eight or nine times the amount of the casein, should be added.

For interior use: Mix 10 parts of casein with 1½ parts of soda solution (90° to 92° Tw.), and add 85 parts of china clay, terra alba, etc.

For exterior use: Take 9 parts casein, 4 parts powdered slaked lime, ¾ part of silica, and about 8 parts of china clay.

Another method: Take 2 oz. of dextrine, 6½ oz. of casein, ½ lb. of gum arabic, 6 lb.

of plaster-of-paris, 2 oz. of borax, and ⅕ oz. of carbolic acid. For exterior use: Take ½ lb. of casein, 6½ oz. of genuine gum arabic, 1 oz. of silica, 5 oz. of slaked lime, 9 lb. of plaster-of-paris, 2 oz. of borax, and $\frac{1}{10}$ oz. of carbolic acid. Dissolve the dextrine, casein, and gum with boiling water, then add the borax and carbolic acid and allow the whole to stand for two or three days, when it will have turned into a thick mucilage. This forms the medium from which most distempers are made. To prepare it for use, add boiling water, then plaster-of-paris and any colouring matter, and thin down to the proper consistency with boiling water. These distempers will be found very durable for both interior and exterior use. If care be taken in preparing the exterior distemper, work treated with it may be washed a few days after applying.

A dry distemper to be mixed with water for use: Take 2 lb. of zinc white, 2 lb. of plaster-of-paris, 7 lb. of paris white, 2 oz. of borax, 1 oz. of alum, 8 oz. of pale dextrine, and 3 oz. of gum arabic. Powder the gum arabic, alum, and paris white, then mix all the ingredients together and pass through a fine sieve. The distemper may now be tinted with the following colours which should under any circumstances be able to resist the action of lime.

For white, the above may be used with the addition of 2 lb. of zinc white; for reds, venetian red, indian red, and vermilion; for greens, emerald green and lime green; for yellows, yellow ochre, raw sienna, and zinc chromes; for blue, ultramarine and lime blue; for purple, purple oxide; for browns, burnt umber, raw umber, and vandyke brown; for blacks, ivory black, lampblack, and carbon black. To prepare the distemper for use, take 1 lb. and pour over it 1 pt. of boiling water. Allow it to remain a short time until thoroughly dissolved, then thin down to the proper consistency with cold water. The quality and cost may be varied by adding more paris white and using a brown dextrine, which is much cheaper.

HOW TO DO "FLAT" PAINTING

The dead surface produced by the almost complete evaporation of the vehicle is called a "flatted" surface, both the paint and the operation of applying it being known as "flatting." This lustreless appearance is very suitable on ceilings which are ornamented in relief, on walls, as well as on woodwork.

Flatting produces a surface almost as dead as ordinary distemper, while it will stand hard wear much better, and, once thoroughly hard, will bear repeated washing with soap and water. It makes a pleasant surface on which to add decoration, whether stencilled or hand-painted, the colours employed. if properly mixed, sinking into the dull ground and presenting a dead effect which is in keeping with the acknowledged rule that decoration for interior work should be without gloss. For work with a badly damaged surface, full of inequalities, where the cost or time at disposal will not allow of preparation suitable for gloss enamel, flatting will produce the most satisfactory result. In showrooms, offices, and other buildings where painting can only be done at the risk of disorganisation of business, the advantage of flatted walls over distemper is very pronounced, since once done they will last for an indefinite period, and may be renewed without any mess.

In conjunction with flatting, the stippler is a very useful tool. It should not, however. be used on woodwork such as doors or panelling, though this is sometimes done, and the worker is urged to attempt flatting on doors and other woodwork without resorting to the aid of the stippler as a smoother, the surface being then more in harmony with the material painted. For walls and ceilings the stippled appearance is without doubt an improvement, while at the same time it simplifies the operation of flatting.

Flatting can only be done with satisfaction on a ground prepared to receive it. The sequence of coats in painting depends in every instance on the finish desired; that is one argument against the use *for all purposes* of ready-mixed paints, although these, in the hands of the experienced craftsman, are in many cases of great value. Flatting may be done with white-lead, zinc oxide, or one of the reduced zinc-oxide paints known as "zinc white," and certain proprietary names. Despite all the claims made for zinc oxide, white-lead holds as yet a prominent place in the affections of British painters; but that may be in large measure owing to the imperfect knowledge of zinc oxide and its application. In the present instance the instructions given are for white-lead flatting.

In the case of new woodwork three coats, irrespective of the flatting coat, will be absolutely necessary; where the cost permits, four coats and flatting will be an advantage. Such a surface, costing more to begin with, will repay the extra outlay, by reason of its power of resistance to atmosphere and ill-usage. The sequence of coats for new wood that is to be finished flat is: priming, 2 parts of oil, 1 part of turpentine, and necessary driers; second coat, 2 parts of turpentine, 1 part of oil, and necessary driers; third coat, 3 parts of oil, 1 part of turpentine, and necessary driers. If four coats exclusive of flatting are to be given, the order may be: First and second coats, as before; third coat, 1 part of oil, and 1 part of turpentine; fourth coat, 3 parts of oil and 1 part of turpentine.

Where flat or semi-flat coats follow close on each other the work is inclined to be coarse or "ropy." By applying the coats in the order given, and not using too thick a paint, a smooth, fine surface should result.

The Flatting Colour.—The flatting colour requires some attention; it is next to impossible to go over flatting a second time and get a perfect appearance, or one that will successfully resist usage, and the only proper course where the flatting is a failure is to give a coat of oil colour and flat again.

Strictly, in ordinary painting, the successive coats of paint should provide an elastic film over a brittle one. In the case of flatting, the order seems contradictory, but is not so in fact. There is a proper moment for the application of flatting, which, taken advantage of, will cause the two coats—that is, the last oil and the flat—to become practically one; that moment is reached when the undercoat is just tacky. Applied then, the flatting does not lie on the surface of the glossy oil paint and cause cracking, but sinks into it, and the two films are united.

Flatting for white and pale tints should consist of white-lead, half the amount of driers advised for oil paint, and turpentine, there being a small amount of oil in the paste white-lead. Such a flat would, however, need expert working owing to its drying off quickly, so that it is advisable to add a little pale copal varnish (rather less than a tablespoonful to a pound of paint) to act as a binder and to retard the drying. The same proportion of pale gold-size, flatting varnish, or even linseed oil, will answer the same purpose.

Flatting should be made thin, strained, and set aside at least a day before use. If mixed and used directly, it will dry off so quickly as to give the operator scant time to spread it. To the experienced painter this will not be of so much consequence; but the amateur is recommended to make it at least a day previous, so as to allow the "fire"—that is, the tendency to sudden drying—to give place to cooler and freer working.

Applying Flatting.—Flatting paint should be laid on plentifully, with a brush long in the bristle. The less brushing consistent with equal spreading given to flatting the better; the crossing sometimes recommended for oil colour should be avoided. Where a stippler is used, it is generally sufficient to spread the paint evenly, and on ceilings and walls the direction may be ignored—leaving it to the stippler to remove the brush marks. Flatting when the work is not stippled should be laid on freely the way of the grain, lightness of touch in the final laying off being necessary to ensure an even, dead surface.

Flatting a Door.—Flatting a four or six-panelled door is a test of the painter's ability. Begin with the panels, laying them in one at a time. If the mouldings are small they may be painted with the panels, wiping off the flatting that may accidentally get on the stiles and rails; or, if preferred, the mouldings may be left until last, and run in with a fitch or small tool. Wipe off at once any flatting that gets on the stiles, for, if left, a ridge will show when the door is finished. The stiles and rails must be brought down together, beginning at the top of the door and keeping the whole "alive," or, in other words, wet at the edge. Some painters work from the bottom of the door upwards, but this is not recommended, as there is always the risk of spots dropping from the brush on to the finished part. When the mouldings are left until last they should be run in carefully, so as not to touch either panels or stiles.

Panelling and other surfaces should be mentally divided for breaks before beginning flatting. Skirtings are easily kept going by beginning on the right-hand corner of a room, or the right-hand side of a door, and working to the left; and frames of doors by beginning at the right-hand base and upwards, the reason being that there is only one edge, and that an inconsiderable one to keep wet.

In using the stippler, only the extreme ends of the bristles should come in contact with the wet paint, for if it is banged on the work, or dragged over it, the surface will be coarse and rough. Nor must the brush be allowed to get clogged with paint, or the work will be full of lumps where the flatting gathers; but it should be rinsed frequently by dipping the tips of the bristles in clean turpentine and drying on clean paper.

The chief point to remember when painting with flatting is not to miss any part, as it cannot afterwards be touched up properly. For this reason, when flatting a ceiling, the worker should work from the light. Frequently the flat paint and the previous oil coat are exactly alike in colour, when the glossy ground may appear covered and deceive the inexperienced. It is advisable, therefore, whenever possible, to have the previous coat a trifle darker than the flat, as the latter will sink and present a more solid and satisfactory appearance than if the opposite order is adopted.

Flatting Walls.—The flatting of a large wall is an extremely difficult job for the amateur. In the trade, the job would be done by three, or, better still, four men; two pairs of steps and a double plank would be employed; one man would lay in the top part, and another immediately after meet it from the bottom, while behind each would follow the stipplers. All windows should be closed, or, perhaps better, nearly so, in order to retard the drying off of the paint; but as soon as the flatting is completed more air should be allowed into the room, since the turpentine throws off a pungent smell, besides causing the eyes to smart or slightly water.

Where the work has to be done single-handed, and a perfect flat is not absolutely essential, the colour may be made to dry more tardily by adding a little linseed oil or pale copal varnish. Such a surface is sometimes called a bastard flat; but it is recommended on large flanks, where, by reason of lack of assistance, the other is impossible.

Using Zinc White.—Flatting can be done with zinc white, one of its advantages over lead being that it will not, in the case of snow white, so readily change in the presence of sulphuretted hydrogen. Another great advantage of its use is that it is non-poisonous. Where zinc oxide is substituted, it is advisable to use it also on the previous coat, though the first, second, and third coats may be of lead.

Zinc paint requires a larger proportion of oil than does white-lead, and it must not be made too thin; zinc driers should be substituted for the usual paste-lead driers, and refined boiled linseed oil for raw linseed oil, while a good pale gold-size and mixing varnish should be used.

The coat previous to flatting should be mixed with 3 parts refined boiled oil, 1 part turpentine, with the necessary liquid zinc driers. A little mixing varnish added will be an improvement. The flatting coat consists of 6 parts of turpentine, 1 part of oil, with the necessary liquid driers, gold-size being substituted for the mixing varnish.

Missed Places. — Although missed places on flatting cannot properly be touched up, they may with care frequently be remedied without the necessity of oiling in again. Where, unfortunately, a place is missed on a panel, a flank of a wall, or the bed of a ceiling, it is sometimes made good by thinning some of the flatting, and, noting that the previous coat is thoroughly dry, painting the flank quickly and without much brushing, so as not to move the under-coat.

Recipes for Furniture Revivers

(1) Mix together ½ pt. of vinegar, 1 noggin of methylated spirit, and a tablespoonful of raw linseed oil. Use on a piece of soft rag.

(2) Mix together equal parts of vinegar, sweet oil, and spirit of turpentine. Apply this with a piece of soft flannel, and rub down with a soft silk handkerchief.

(3) Wash well with soap, soda, and water; dry well, then revive with raw linseed oil, vinegar, and paraffin oil in equal parts.

(4) Warm 3 pt. of turpentine, 12 oz. of castile soap, 12 oz. of white wax, 4 oz. of butter of antimony, and 1 gill of vinegar over a slow fire.

(5) Mix together, cold, ½ pt. of linseed oil, 2 oz. of distilled vinegar, ½ oz. of muriatic acid, 1 oz. of spirit of wine, 1½ oz. of oil of almonds, ¼ oz. of muriate of antimony, and ¾ oz. of spirit of hartshorn. Shake the mixture and pour a little upon a clean rag, rub the furniture well, and finish off with a piece of clean, soft rag. The mixture must be shaken each time the rag is replenished.

(6) Thoroughly mix together 1 pt. linseed oil, ½ pt. methylated spirit, ½ pt. white wine vinegar, and 2 oz. butter of antimony. Mix well together, shake each time used, put a little on wadding or flannel, and rub briskly. Wipe off with clean, soft rag.

(7) A varnished or french-polished surface may be cleaned with soap and a moist flannel, a moist flannel alone, or a rag wrung almost dry after dipping in paraffin oil. The polish may be revived by rubbing with the following polish: a piece of gum sandarach as big as a walnut is simmered with ¼ pt. boiled oil till dissolved, and, when this is nearly cold, ¼ dr. Venice turpentine is added. Thin this, if necessary, with oil of turpentine.

(8) A good renovating medium is camphorated oil, rubbed on very lightly and quickly with a soft flannel rubber.

(9) Before using this, wash the furniture with a solution of about two tablespoonfuls of extract of soap in a pail of warm water. To polish, apply the following mixture with a soft pad: take ½ pt. each of linseed oil and vinegar, boil them together, and, when cool, add ½ pt. of methylated spirit. This method may be applied to polished or painted furniture.

(10) Besides thoroughly cleansing the furniture this reviver leaves a good polish which is not easily soiled by finger-marks. Mix together spirit of wine 1 pt., vinegar ½ pt., boiled linseed oil ¼ pt., turps ¼ pt. Mix the spirit and vinegar first, shaking well till of a creamy colour; then add the other ingredients, and mix all well together, keeping it tightly corked. Apply with a clean cloth, which must be dry, rubbing well in, and polish off with a dry flannel.

(11) Thoroughly mix ¼ pt. lime water, ¼ pt. linseed oil, and then add ⅛ pt. sweet oil, well mixed, afterwards thinning with nearly ¼ pt. of turpentine. Apply with wadding or soft rag, wipe off, and finish with soft, clean rag moistened (but not wet) with methylated spirit. If the work is very dirty or sticky with wax, it should first be well washed with weak soda and water.

Woodworking: Various Joints

THIS chapter will explain and illustrate the making of some of the simplest joints used in woodworking, and will show their applications.

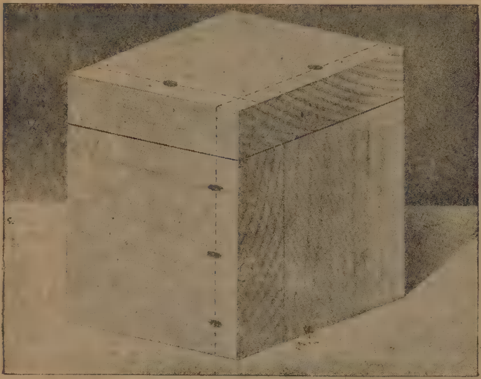


Fig. 1.—Butt Joints, Nailed

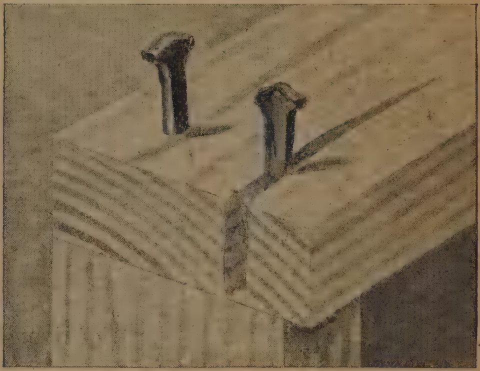
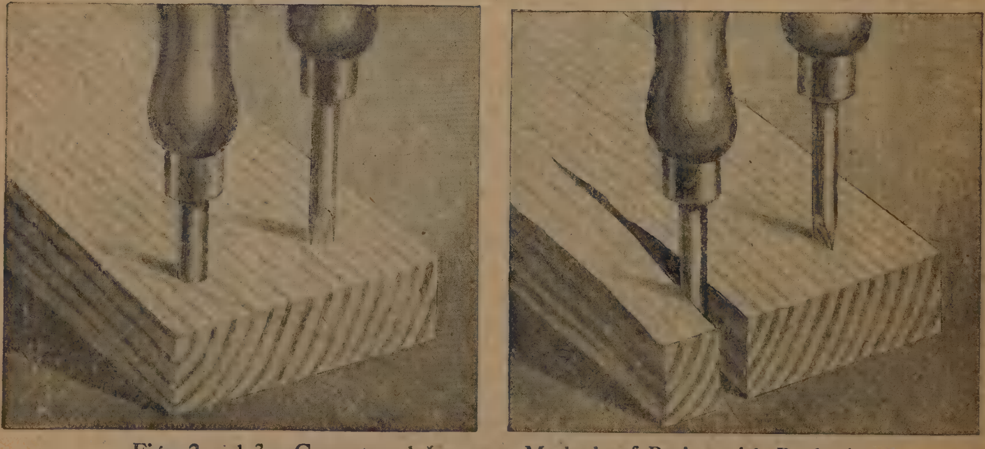


Fig. 4.—Driving Cut Nails



Figs. 2 and 3.—Correct and Incorrect Methods of Boring with Bradawl

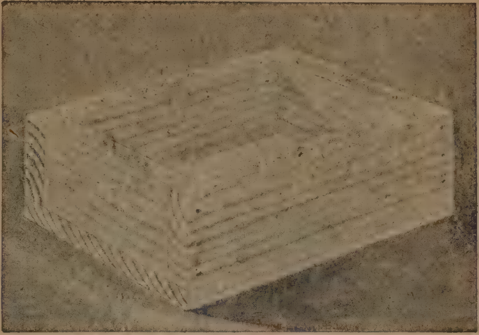


Fig. 5.—Simple Butt-jointed Box

Butt Joint, Nailed.—This is the commonest kind of joint, and at the same time perhaps the most useful. One of its forms is shown in Fig. 1, which is a view of a box with the bottom uppermost. As will be seen, the parts are butted together and fixed with nails.

Using the Bradawl.—For small boxes in which the wood is ½ in. or less in thickness, it is generally best to make holes with the bradawl, so as to provide an entrance for the nails and obviate splitting. To avoid splitting the wood when using the bradawl, hold the latter vertically, and with the cutting edge across the grain as shown in Fig. 2; then, with two or three light blows with the hammer or mallet, the point can be driven right through the wood without splitting it. A piece of waste wood should be placed under the work so as to prevent damaging the bench. The awl can then be withdrawn. When boring near the end of pieces, this method is far better than forcing the bradawl forward and at the same time giving it a number of quarter-turns imparted by the motion of the hand alone, that method frequently causing splitting. Fig. 3 shows the common effect of placing the cutting edge of the bradawl with the grain.

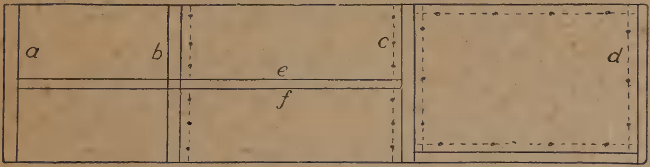


Fig. 6.—Wood Set Out for Simple Box

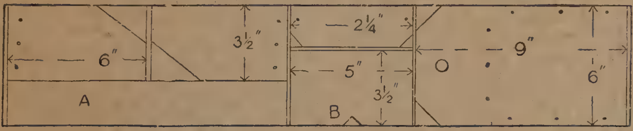


Fig. 8.—Wood Set Out for Soap-box

Nailing.—For the general purposes of the amateur, the french or wire nails are to be preferred, especially those of oval section, as they hold well, and are not so likely to split the wood as the cut nail or cut brad, which is tapered in breadth, as shown by Fig. 4, where it will be observed that the wood has been split by the nail being driven with its breadth across the grain. When this kind of nail is placed with its head parallel to the grain, splitting does not take place, because there is little, if any, taper in the thickness of the nail. The general rule is to place all nails with the length of their heads in the same direction as the grain of the upper piece of wood.

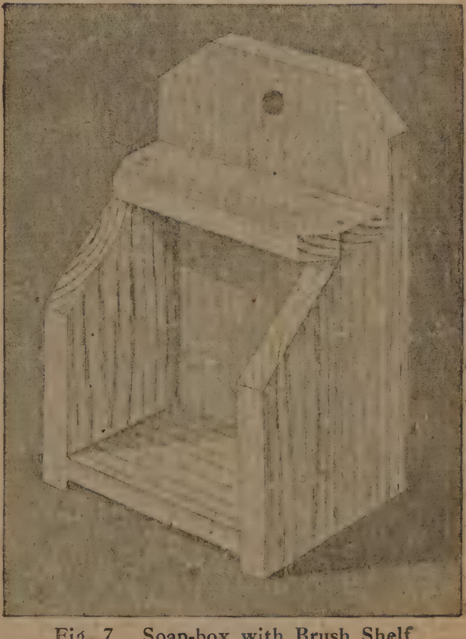


Fig. 7. Soap-box with Brush Shelf

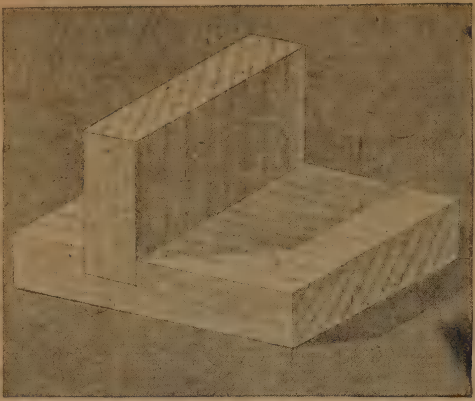


Fig. 9.—Housed Joint

Making a Simple Butt-jointed Box.—An ordinary and useful application of the butt joint is exemplified in the making of a butt-jointed box as shown in Fig. 5. The dimensions are not given, as, of course, they depend upon individual requirements, but suggested sizes are: 10 in. long, $6\frac{1}{2}$ in. wide, and 3 in. deep, the thickness of the material being $\frac{1}{2}$ in. Working to these dimensions, a piece of board $\frac{1}{2}$ in. thick, 7 in. wide, and about 2 ft. 4 in. long, would be suitable for the making of this box. Having procured the wood, plane the face side and each of the edges true; then gauge and plane to thickness. Next, by means of the rule, try-square, and scriber, draw lines across the board marking off the lengths of the different pieces and leaving a little space between each one and the one next to it, as shown at *a*, *b*, *c*, *d* (Fig. 6). This will allow, if desired, for the ends of each piece to be pared or planed smooth. Now set a gauge to the width of the sides and ends, and gauge lines *e* and *f* and also for the width of the bottom. Bear in mind that the endpieces of the box are shorter than its breadth by the amount of the thickness of the two sides. Next mark out half the thickness of the stuff and the positions of the nails. It will obviate splitting if the holes are now bored with a bradawl. Separation of the parts can be effected either by sawing closely to the line or by sawing down the middle of the waste. If the latter method is adopted, the waste material still remaining can be removed, if end grain, by paring with a chisel; or, if straight grain, by planing. The parts can now be assembled and carefully nailed, taking particular care that the various parts are flush with one another before driving the nails home.

Making a Soap-box with Brush Shelf.—Fig. 7 illustrates a useful model, which will afford further practice in the making of butt joints, while it also introduces paring obliquely with the grain,

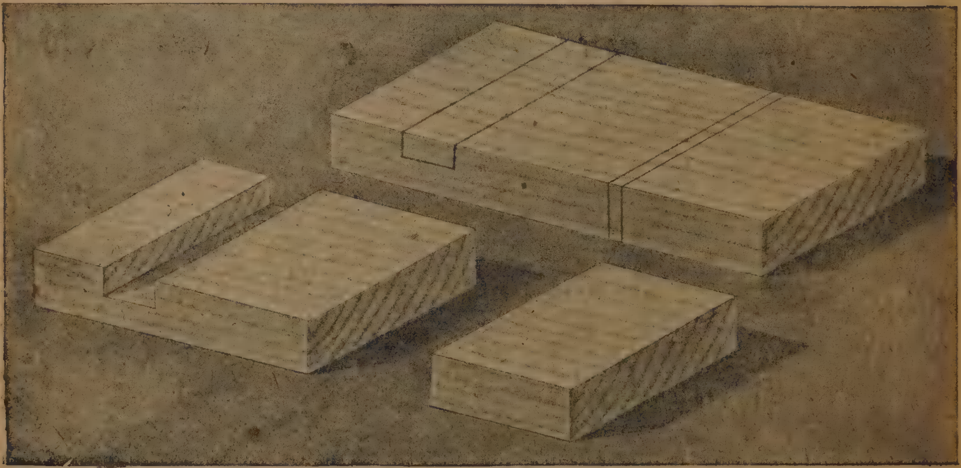


Fig. 10.—Housed Joint: Setting Out, Housing, etc.

described and illustrated in an earlier chapter. Fig. 8 shows the complete development of the box, all the parts being marked out on a piece of board planed up to ½ in. in thickness and 6 in. in width, and of length about 1 ft. 10 in. The piece at A is to spare. The triangular space at B is at the back of the bottom shelf, and should be removed with a chisel; it serves the purpose of a draining hole. The hole providing for suspension can be bored with a brace and bit. The bottom shelf is inclined towards the back so that the water may drain off with facility, and also to prevent the soap from sliding out at the front.

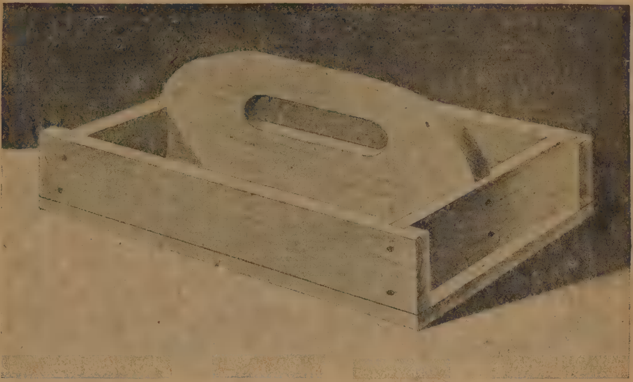


Fig. 11.—Knife-box

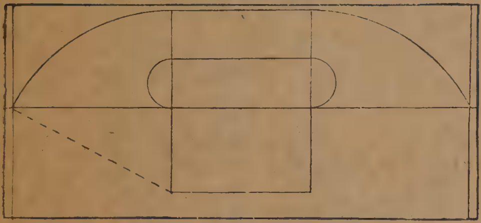


Fig. 13.—Knife-box Partition Piece Set Out

Making a Housed Joint.—Housed joints are of very general use. Fig. 9 is a view showing the completed joint in its simplest form. The upper view in Fig. 10 shows the piece of wood planed up to breadth and thickness, the length of each piece set out, and also the housing. In setting out for the housing, the distances between the lines should be about $\frac{1}{32}$ in. less than the thickness of the wood. The sawing and paring should next be done taking care to work in the waste as already shown and described in an earlier chapter, and so as to make the hole right through the piece of wood.

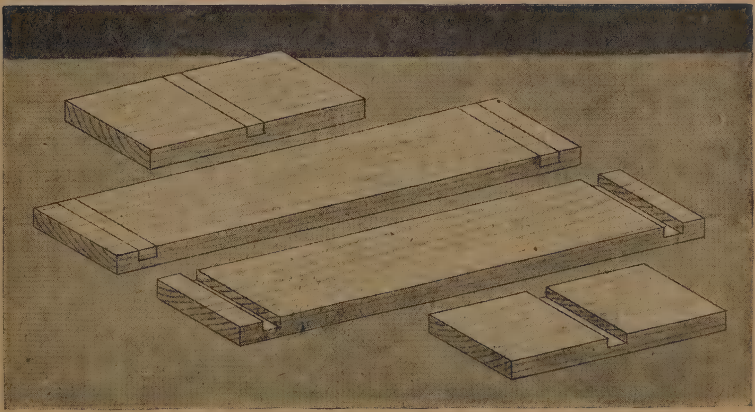


Fig. 12.—Sides and Ends of Knife-box Set Out and Housed

Making a Spoon- or Knife-Box.—This provides a good application of the housed joint (see Fig. 11). A suitable size would be 11 in. long, 7 in. wide, and 2½ in. deep, these being the outside dimensions. The thickness of the wood should be such as will measure ⅜ in. after planing up. The sides and ends should be planed truly to the required thickness and breadth, then set out for the length of each piece, and afterwards sawn off near the lines. The ends should be finished by overhand paring with the chisel.

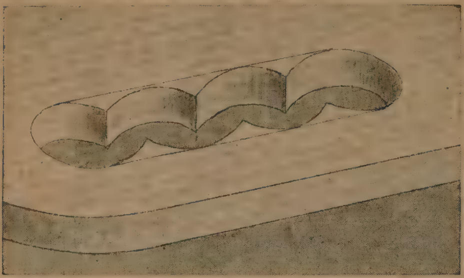


Fig. 14.—Boring for Knife-box Handle

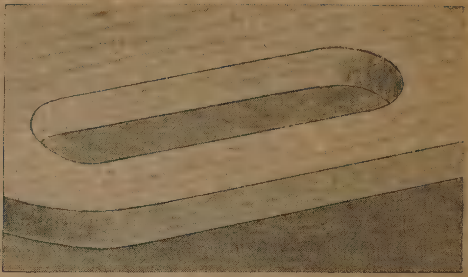


Fig. 15.—Slot in Knife-box Handle

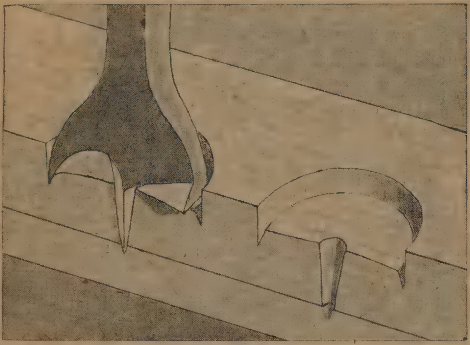


Fig. 16

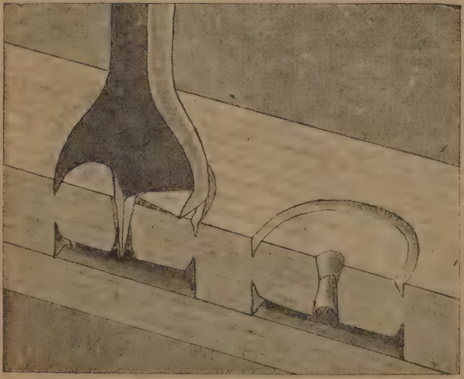


Fig. 17

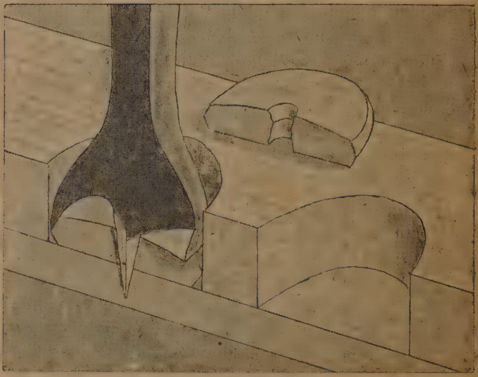


Fig. 18

Figs. 16 to 18.—Boring from Front and Rear Sides, and Completing the Boring. (Illustrations show the work partly in section)

The housings should next be set out as shown in Fig. 12. By carefully sawing in the waste and paring, the pieces are thus prepared ready for putting together. Fig. 13 shows a simple method of setting out the partition piece. The curved portions can be pared according to the directions given in an earlier chapter.

The slot forming the handle can be made by boring four holes with the centre-bit, and the work will then appear as in Fig. 14. Then, by overhand paring with the chisel to the tangent lines and finishing with a piece of glasspaper, the slot will be completed as in Fig. 15.

Boring Thin Stuff with the Centre-bit.—A good method of boring thin material by means of the centre-bit will now be explained. First, carefully mark the position of the centre of each hole. Then, placing the work on a piece of waste wood and the centre of the bit in the first mark, bore until the point of the bit just projects through the other side, as shown in Fig. 16. Endeavour to hold the tool so that the axis of the bit is square (that is, at right angles) to the face of the work. Now turn over the work, place the point of the bit in the hole from which it previously projected, and with the "nicker" or side cutter of the bit make a deep incision, as shown in Fig. 17, but not taking off any shavings with the cutting edge. Now turn the work over, and finish the boring from the first side, as indicated in Fig. 18. If the boring is carefully done a disc will come out; half of one of these is shown in Fig. 18. It should be noted that the views Figs. 16 to 18 are partly sections through the thickness of the wood in order more clearly to show the action of the bit, etc.

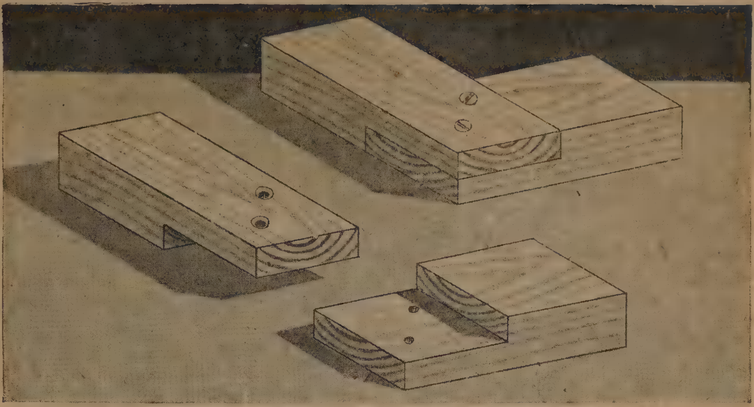


Fig. 19.—Angle-lapped or Angle-halved Joint

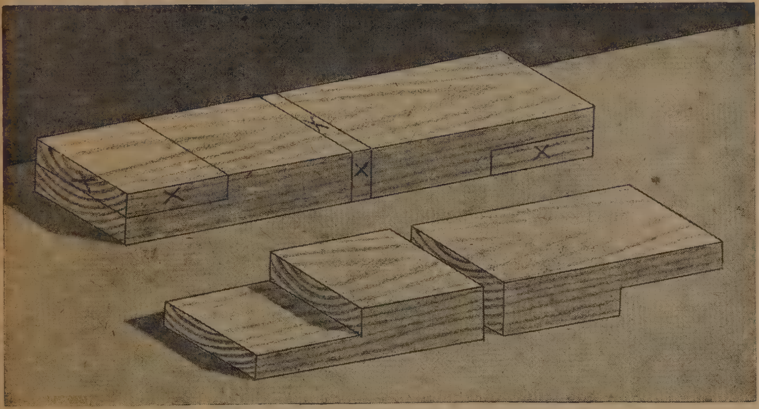


Fig. 20.—Angle-lapped Joint Set Out, etc.

Angle-lapped or Angle-halved Joint.—Two views of this joint are given in Fig. 19. This joint will suggest itself as useful for a great variety of purposes, especially for light frames and structures such as meat safes, rabbit-hutches, fowl-houses, etc. In Fig. 20 is shown

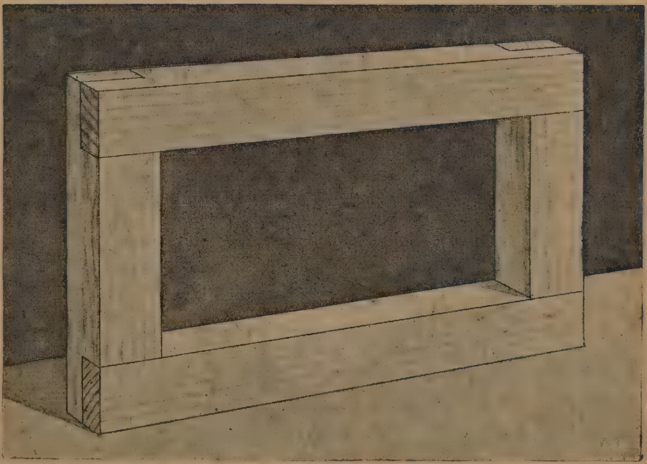


Fig. 21.—Frame with Angle-lapped Joints

the piece of wood planed up true to size, with the ends sawn or pared off true, and then set out. After this the sawing should be done in such a way that all the saw kerfs are made in the waste x (Fig. 20). The fastening together of this form of joint can be by means of glue, nails, or screws, whichever is most suitable for the purpose required.

Construction of a Rectangular Frame.—Fig. 21 shows a frame constructed with angle-lapped joints. In Fig. 22 a horizontal and a vertical piece are each shown in two stages. The wood having been planed to breadth and thickness, and sawn or pared true to length, the setting out is done, then the sawing with the grain and across the grain for the shoulders which are shown not quite completed in two pieces at the back in the illustration, where it will be seen that the kerfs are represented as being just in the waste. The two foremost pieces are ready for putting together. If for outside work, the contact parts of the joints should be painted and then screwed or nailed together. For inside purposes, the best plan will be to glue the contact surfaces of the joints and, if desired, further secure with screws or a couple of fine brads. If any part of the ends project, they can be cleaned off with the chisel by overhand paring.

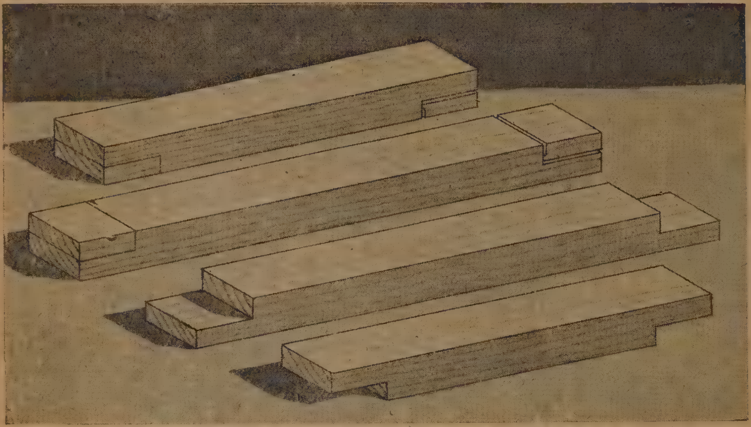


Fig. 22.—Parts of Frame Shown in Two Stages

DOWELLING

Dowelling is an excellent method of securing joints of framework, as an alternative to screws, mortise-and-tenon joints, etc. It is invisible, on which account, and because it is quickly done and very strong when properly carried out, it is used extensively in cabinet-making.

When it is desired to joint up boards for flaps, table-tops, etc., the butting edges of the joints should first be planed so as to fit accurately. Then, placing the two face sides outwards and the butting edges in the same plane, and holding them together by means of hand-screws or the vice, the distances apart of the dowels should be marked off (this will vary from 6 in. to 1 ft., according to the strength required). Then, by means of a try-square and a striking knife, draw lines through the points across both edges. Setting the gauge to half the thickness of the material, make a short gauge line so as to intersect the lines already squared across, as shown in Fig. 23. The reason for placing the face sides of the boards outwards is that the gauging may be done from the face side in each case.

The Dowels.—Obviously, for most purposes, straight-grained hardwood is the best material for the dowels. Straight-grained wood is desirable because the best dowels are made by splitting them off the material and not by sawing. As dowels vary from $1\frac{1}{2}$ in. to 4 in. in length, according to the purposes for which they are required, blocks should be sawn off from a board of the desired length and pieces split off from $\frac{1}{2}$ in. to 1 in. square in section, according to the diameter required. Sometimes the blocks are sawn off sufficiently long to make two or three

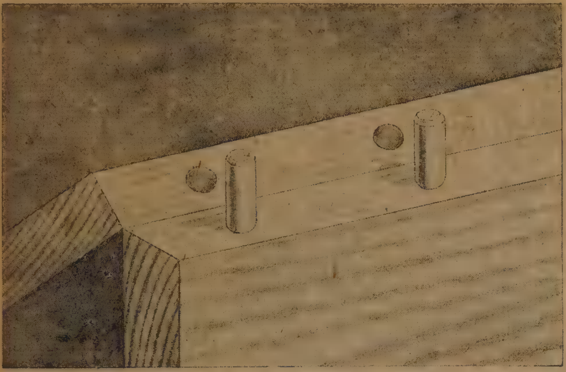


Fig. 25.—Dowel Joint in Position Ready for Gluing

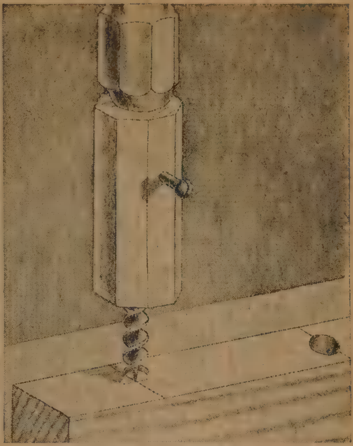


Fig. 24.—Depth Gauge on Auger Bit

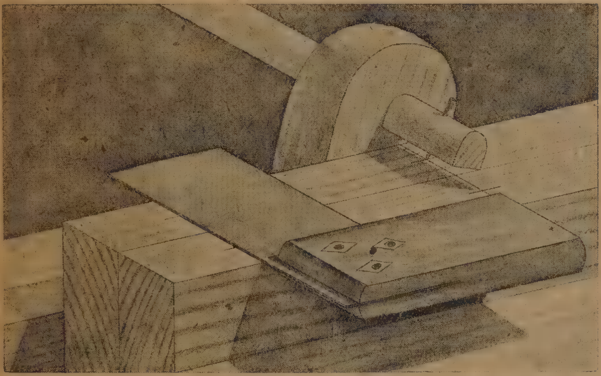


Fig. 23.—Setting Out Edges of Boards for Dowelling

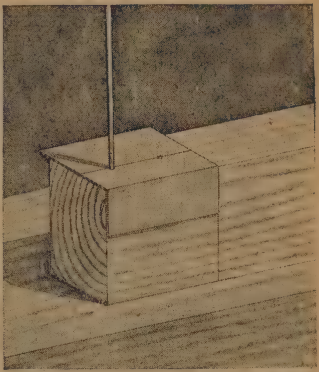
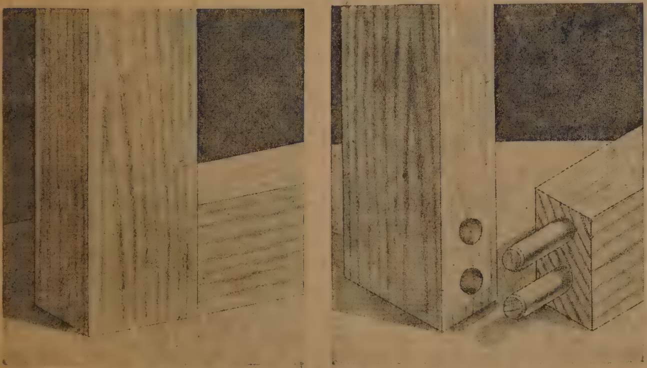


Fig. 28.—Metal Template on Stile



Figs. 26 and 27.—Dowelled Joint in Framing

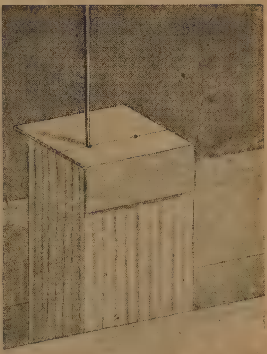


Fig. 29.—Metal Template on End of Rail

or more dowels in one length. These pieces are then shaped to hexagonal section and finally rounded with a plane, testing them for diameter by passing them through a hole of the right diameter made in a piece of hardwood. It is a good plan to drive the dowels when planed up through a hole in a piece of hard oak, or, better still, of wrought iron, which will take off any sharp arrises or projecting pieces. The sharp edge of the hole made by a drill in the iron acts as a scraper, which removes all superfluous material.

Dowelling sticks ready for use may be obtained from many timber merchants and tool dealers for about a farthing per foot run.

Boring Dowel Holes.—An auger bit will be found most suitable for this purpose, and far superior to the old-fashioned shell or pin bit, as the point can be placed exactly on the intersection of the squared line and gauged line as indicated at Fig. 24; as there illustrated, a gauge can readily be made out of a piece of wood, so that the bit shall only bore into the wood the

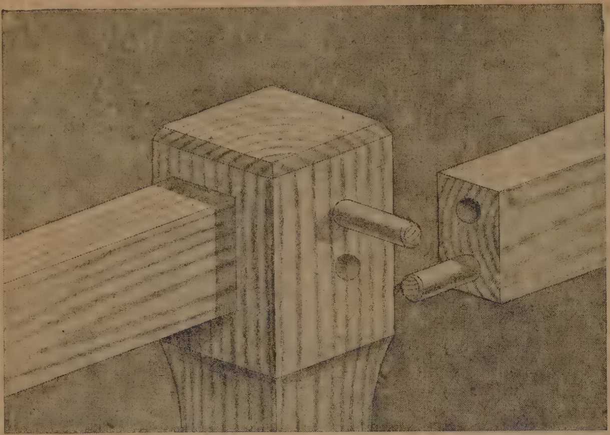


Fig. 30.—Rails Dowel-jointed to Leg

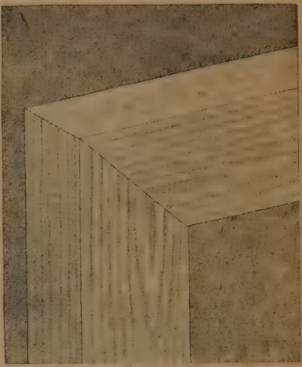


Fig. 31.—Dowelled and Mitred Joint Complete

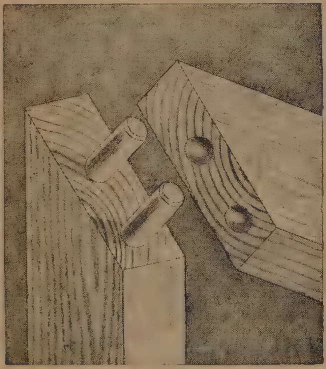


Fig. 32.—Dowelled and Mitred Joint Apart

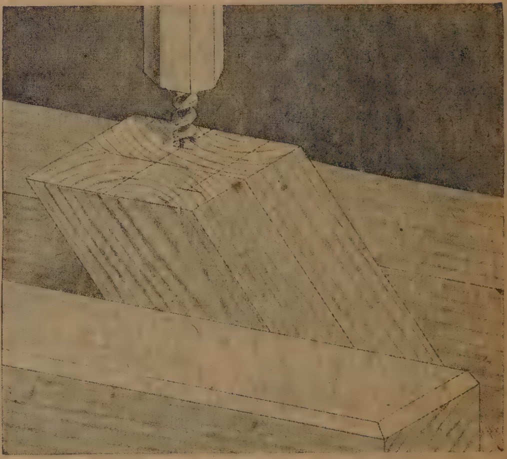


Fig. 33.—Setting Out and Boring for Dowels

desired depth. This gauge is made from a piece of 1½-in. square stuff bored, with the bit that is going to be used, lengthwise of the grain; by planing off the corners, the gauge can be made octagonal in section. Then, by boring a couple of holes at right angles to the grain and inserting two screws the wood is fixed to the bit and will retain its position. In all ordinary cases it is important that the boring should be done quite square to the surface of the joint. Having bored the holes it is advisable to countersink them slightly in order to remove any rough wood fibres left by the bit, which might get between the butting edges and prevent the joint closing when fitting together. It is necessary that the dowels should be about ⅛ in. shorter than the combined depths of the holes, as, obviously, by whatever amount the dowels were too long, by that distance, also, would the joint be kept apart on fitting together. The ends of the dowels should be chamfered off, either with a file or chisel, as shown in Fig. 25. It is a common practice in gluing up a joint of this kind first to glue the dowels into one half of the joint and then placing the parts in the positions as indicated, to glue both edges as quickly as possible, allowing a little glue to flow into the empty dowel holes. The two parts are then rapidly assembled and cramped up. The glue used in joints of this description should be slightly thinner than that used for rubbed joints, because all superfluous glue has to be removed by pressure, and not, as in the former case, by rubbing.

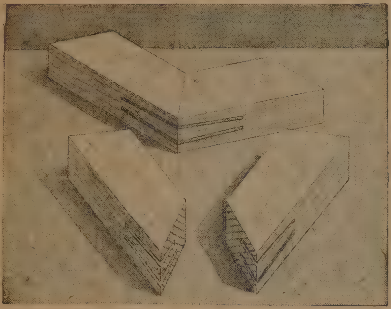


Fig. 34.—Keyed Mitre Joint

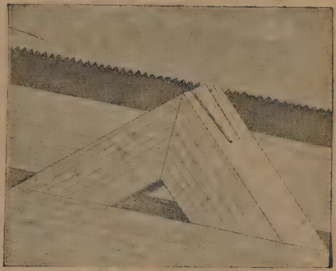
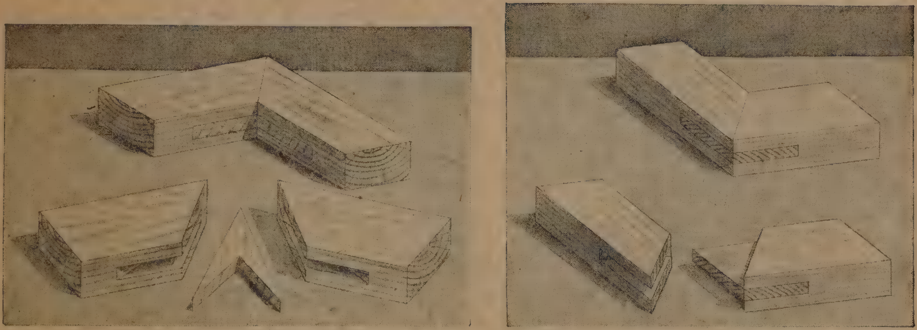


Fig. 35.—Method of Sawing Kerfs to Receive Keys


Figs. 36 and 37.—Mitred Joints Mortised on Inner and Outer Edges Respectively

The joints of stiles and rails of doors which may be prepared to receive glass, wood or other panels are frequently con-

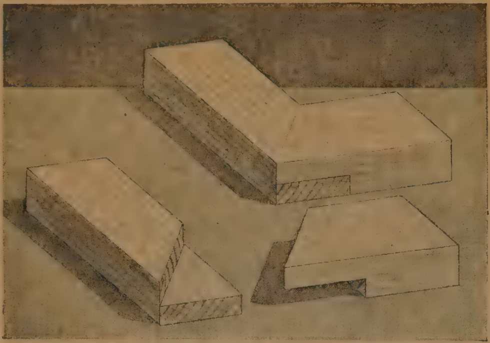


Fig. 38.—Mitred and Lapped Joint

nected by means of dowels. A typical example, showing one corner only when fitted together, is shown by Fig. 26, and apart by Fig. 27. A simple way of setting out for the dowels in such cases is to obtain a piece of tin-plate or thin sheet-zinc and to bend this so as to form a flange about $\frac{1}{2}$ in. wide; the centres of the desired dowels can be marked out on the metal and small holes punched through. Then, after cutting this metal template to length, it can be applied to the stile (see Fig. 28), and, with a marking awl, small holes are made coincident with those in the template on the edge, ready to receive the gimlet point of the bit. The template is next applied to the end of the rail (Fig. 29) and the positions of the centres of the dowel holes marked. By using a template, the positions of the dowels are accurately marked and, if the boring is carefully done, the two parts will properly fit together without any easing of the dowels or holes, which has always to be done if the setting out has been done inaccurately.

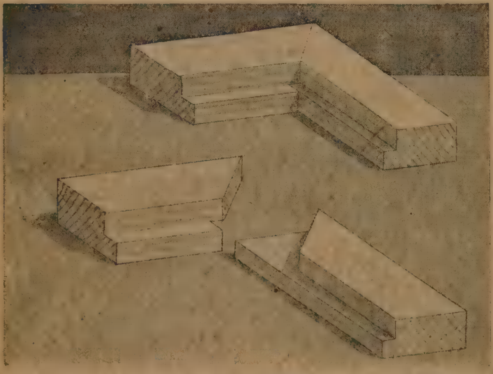


Fig. 39.—Mitred and Lapped Joint for Rebated Frame

At Fig. 30 is shown the application of dowelling between a leg and the rails of a chair or similar framing.

MITRED JOINTS

When it is desired to mitre the corner joints of frames, doors to cases, etc., a stronger joint must be adopted than just butting, gluing and nailing, as in picture-frame making. The joints here shown are suitable for a variety of applications.

Dowelled and Mitred Joints.—Figs. 31 and 32 show a dowelled and mitred joint, together and apart. A good method of setting out and boring this joint is shown by Fig. 33. The two parts are placed together so that the face sides are outwards; the mitred surfaces are in one plane and placed approximately horizontally in the bench vice. Lines are then squared across and, with a marking gauge set to half the thickness of the material, short lines are made as previously explained. The two surfaces of the joint are now in a horizontal position, and the operator will find it much easier to bore squarely to the surfaces of the joint than if they were not so placed because he is able to hold the bit in a vertical position.

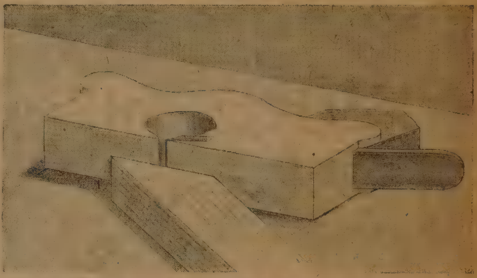


Fig. 40.—Shooting Half-mitre with Shoulder Plane

Keyed Mitres.—The three mitred joints shown by Figs. 34 to 37 can be cut in the ordinary mitre box and planed true with the trying plane and mitre shoot. In the case of the joint shown by Fig. 34, after it has been shot true the two parts should be firmly fastened in the bench screw, and sawn as indicated in Fig. 35, thus making a space for the insertion of a thin piece of hardwood or veneer. Two saw kerfs are shown, and these are not parallel but of dovetailing form, thus greatly strengthening the joint and rendering it less likely to come apart. The joint should be glued and cramped together, and the pieces of veneer glued and inserted. If it is objectionable for the keys to be seen in the outer edge, the saw kerfs can be made from the inner edges, and then the keys would be inserted from those edges somewhat similar to that illustrated in Fig. 36, only instead of mortises there would be one or more saw cuts.

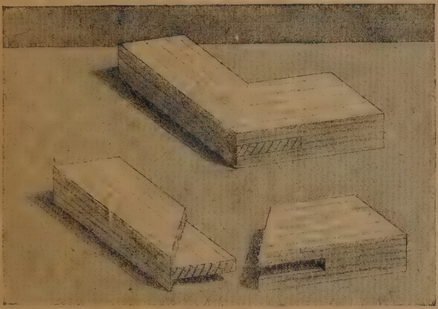


Fig. 41.—Open Mortise-and-tenon Mitred Joint

The joint shown by Fig. 36 is made by first producing a true butt joint; then, the distances along the mitres and edges having been marked off, a mortise gauge should be set to suit the chisel to be used —as in mortising—and the work gauged between the cross lines. Both pieces can now be sawn, the kerf being made just inside the gauge lines as has been described for making an open mortise. The waste should be mortised and pared out and the key prepared to thickness and fitted in. If desired, the mortises, instead of being made triangular in shape, may be cut out rhomboidal in form, which will allow of the key being of right angle form at its inner end, instead of about 45° as shown.

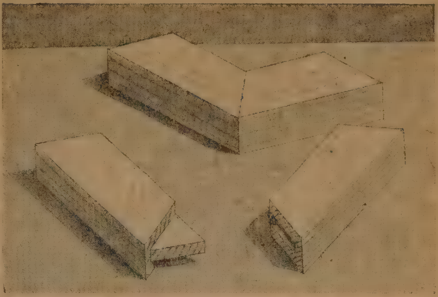


Fig. 42.—Secret Mortise-and-tenon Mitred Joint

This will, of course, allow of a larger key and thus give more strength to the joint. Fig. 37 shows a strong and easily made form of mitre joint with two open mortises, and an inserted key or false tenon.

Angle-lapped and Mitred Joint.—This (see Fig. 38) is a useful and fairly strong form of joint, and, if desired, allows of being strengthened by screwing from the back. Fig. 39 is the same kind of joint forming part of a rebated frame. In this and the following mitred joints it will be seen that the joints cannot be shot true with the plane and mitre shoot; therefore, very accurate setting out will be necessary, and then the mitres sawn near to the lines, finishing just to the scribe lines by a rebate plane, or, what is still better, with a metal shoulder plane, a general form of which is shown in use in Fig. 40.

Open Mortise-and-tenon Mitred Joint.—This useful joint is shown at Fig.

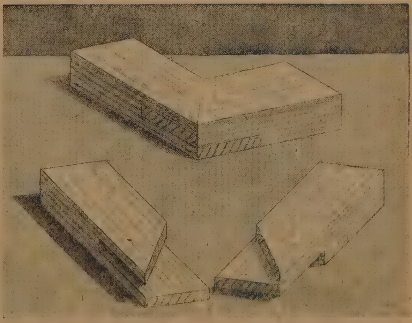


Fig. 43.—Lapped Bridle Mitred Joint

41, where it will be seen that the mitre of the mortise piece can be shot in the mitre shoot, but the shoulder of the tenon must be planed as mentioned above.

A later chapter describes in close detail the making of the various mortise-and-tenon joints.

Secret Mortise-and-tenon Mitred Joint.—Fig. 42 shows this joint together and separated; it is a strong joint and suitable for the best work where it is desirable that the connecting parts shall not be observable.

Lapped Bridle and Mitred Joint.—The joint shown at Fig. 43 is somewhat difficult to make, but when properly made and glued — and, if necessary, further secured from the inner side with screws—produces very strong and reliable construction.

Varnishing a Violin

In varnishing violins with amber oil varnish, the fiddle in the "white" must first of all be glasspapered to dead smoothness with No. 0 glasspaper, and all trace of glasspaper and any other dust scrupulously removed. Also the varnishing should be done in warm weather, or at least in a warm room, which should be kept as free as possible from any commotion that would be likely to cause dust. However, with due precaution against dust, a current of air materially assists the drying process, and it should be understood that the proper thing for applying the varnish is a french hoghair brush, flat pattern one about 1 in. wide is most suitable. The whole violin excepting the neck being varnished with the oil varnish, therefore suitable pieces of cork are fitted into the peg-holes and smoothed off level with the cheeks of peg box to prevent trouble with the varnish getting into the peg holes, which are left unvarnished, and finished to peg "grippiness" with chalk wrought into the wood with the fiddle pegs.

To proceed with the varnishing: the head and peg box are done first, then the top bout ribs and heel of the neck, then the waist ribs and lower bout ribs, then the back and, lastly, the belly. The brush should not be flooded, but the varnish rather sparingly applied, and as it does not set quickly, it gives ample time for "sleeking" each coating, and thereby smoothing down to prevent clotty parts. Although when newly done the varnishing may look streaky (with brushing), it is the nature of the varnish to "smooth out" in process of drying. It becomes surface dry in twenty-four hours (half that time in favourable weather); but the work should be set aside for a week to let the varnish harden before rubbing down. The rubbing down is done between each coat with a damp flannel pad and pumicestone-powder, rubbing lightly all over french-polish fashion, until a dead smooth surface is produced, care being observed to remove all trace of pumice and moisture before applying the succeeding coat of varnish. Three coats of amber oil varnish are sufficient; but after applying the last coat the instrument is all the better for being allowed to harden for a month before the final rubbing down and polishing. The rubbing down is as already detailed, and the gloss brought up afterwards with a clean flannel pad and tripoli powder, sparingly lubricated with olive oil, and finally a brisk rubbing up with a soft silk rag.

For finishing the neck a solution of ammonia and lampblack is used, two coats being given, and when dry rubbed down with No. 0 glasspaper, after which a coat of spirit varnish is applied and polished with tripoli and oil.

Making and Fixing Roller Blinds

SOME general knowledge of window blinds will be extremely useful to the handyman. Upon taking a house the blinds are one of the first things to be thought about. A removal means taking down and probably altering and re-fitting them ; and, in any case, they are by no means permanent fixtures, and require cleaning or renewing from time to time.

Materials.—The usual materials for making roller blinds are paper, holland and linen. The paper is, of course, the cheapest, but it makes very good blinds, and can be recommended where expense is a consideration. When they get soiled it is less troublesome or costly to make new paper blinds than to have holland blinds cleaned and calendered.

Blind holland is made in various qualities, widths and colours. The cheapest is known as "Lancaster holland," this being a poor material heavily dressed. It is not suitable for cleaning and calendering, and is intended to last till it requires replacing with new stuff. The better qualities of holland can be cleaned almost equal to new by the large cleaning firms, but the cost is considerable. Attempts at home cleaning or laundry cleaning are not successful.

Linen blinds are more expensive in first cost, but they are durable, and can be washed and ironed at home repeatedly.

Rollers.—The rollers with fittings used with the above materials are chiefly "spring rollers," rollers fitted with "Scotch action" fittings, and those with "single action" fittings. The last named have a cord fixed at the right-hand end, and the dropping of the blind winds the cord up between two metal flanges on the fitting ; pulling the cord draws up the blind. It is very simple and can hardly get out of order ; but it is seldom used, except for large shop window blinds.

The "Scotch" fittings are very smooth running, but somewhat expensive. They also require fixing on an independent lath and brackets, and are now used only on large windows of public buildings.

Undoubtedly, the modern "spring roller" is the best all-round article for domestic purposes, though it has some weak points. The rollers are manufactured in 1-in., $1\frac{1}{4}$-in., and $1\frac{1}{2}$-in. diameters, and 3-ft. 6-in. to 5-ft. lengths. Blinds more than 5 ft. wide must have the rollers lengthened ; and it is often necessary to join pieces on rollers. There is no advantage in using a thicker roller than is necessary to support the weight of the blind. The 1-in. diameter roller will do for any size of blind up to 9 ft. in length by 3 ft. 5 in. in width ; but blinds are often required a yard less in length and two or three inches more in width. The $1\frac{1}{4}$-in. rollers (being longer) are often cut down, but sometimes it is more convenient to lengthen the thinner ones. The same applies to the $1\frac{1}{2}$-in. and $1\frac{1}{4}$-in. rollers.

Old solid rollers are cut up for jointing pieces. There are different ways of joining to be adopted as occasion demands. Small pieces up to 1½ in. in length may be glued and secured with three long and fine panel pins, as shown by Fig. 1. It is important to have the joint ends cut quite square, to have the roller straight.

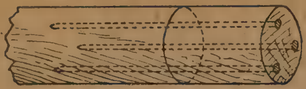


Fig. 1.—Small Piece Added to Blind Roller

It is always as well to have more than one way of doing anything. Figs. 2 to 5 show four different methods of jointing pieces on solid blind rollers from 1½ in. to 3 ft. in length, and when properly done they are all quite reliable. But it is seldom necessary to lengthen by more than 2 ft., and then it is with the thicker rollers.

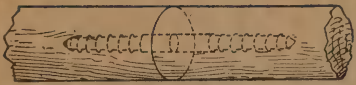


Fig. 2.—Roller Jointed with Dowel Screw

Fig. 2 shows the simplest method—the use of a dowel screw. Fig. 3 is a kind of scarf joint strengthened with sprigs. Fig. 4 requires the use of a wood dowel; and Fig. 5 shows a spliced joint secured with screws and sprigs.

Good fitting and gluing are indispensable to all the joints; and to give extra strength and finish the rollers are sometimes trimmed down a shade all round and a piece of blind material about 6 in. wide glued round.

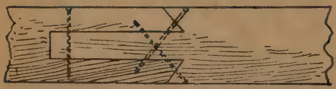


Fig. 3.—Roller Scarved and Sprigged

Making a Blind.—To make a blind, the first thing is to take the measurement of the window between the beads of the casing. Suppose this to be 3 ft., and the length 6 ft., which is a very ordinary size. The finished blind, when drawn down, should cover the two side and the bottom beads, and when rolled up to the top the lower edge of the blind should be just above the top bead. But in many cases an inch or two more in the length and width does not matter, and this gives less restriction in the width of material. For instance, with this blind the width of stuff should be 38 in.; but 40 in. or 42 in. width could be used when there is room on the casing. It is not necessary to hem blinds on the side edges, unless they are cut, and likely to fray. Side hems cause a blind to roll up much thicker, and sometimes the brackets have to be backed out to clear the woodwork. The length of material required for a blind is 6 in. over the measurement between the top and bottom beads, the extra being allowed for the lath hem and for a turn round the roller.

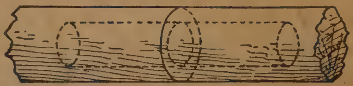


Fig. 4.—Roller Jointed with Wood Dowel

It is most important that the blind should be cut square. To do this, if the work-bench or table is perfectly square, the stuff may be laid on, keeping the long edge even with that of the table, and the top edge about 1 in. from that of the table. The wooden straightedge is laid across even with the edge of the table, and the stuff marked and cut off. The material may then be measured and the other end cut in a similar manner. Fig. 6 shows the blind-cutter's knife.

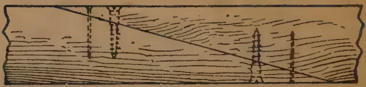


Fig. 5.—Roller Spliced, Screwed and Sprigged

Another way is to cut off the length of stuff roughly, allowing a little over for straightening, to fold the stuff evenly, lengthwise with the two long edges together, to lay it on the bench, and with the point of a knife to stab through about ½ in. from each corner at the selvedges. The stuff may then be opened out on the bench and the wood straightedge laid across at the stab marks to cut the stuff with the knife. This is shown in Fig. 7, as also the treatment of the lower edge for the lath hem, which is first cut straight, then creased for turning in ½ in., and creased for turning up 1½ in. The creased marks are made with a blunt knife that would be sure not to cut. In sewing the lath hem the stitches need not be less than $\frac{3}{16}$ in. in length and $\frac{1}{16}$ in. from the turned-in edge.

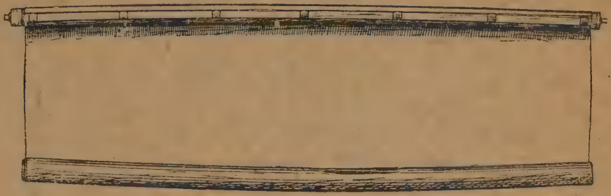


Fig. 8.—Method of Attaching Blind to Roller

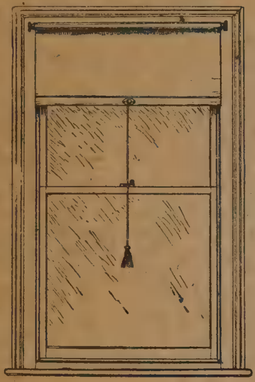


Fig. 9.—Finished Blind

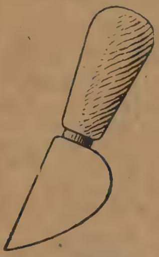


Fig. 6.—Blind-cutter's Knife

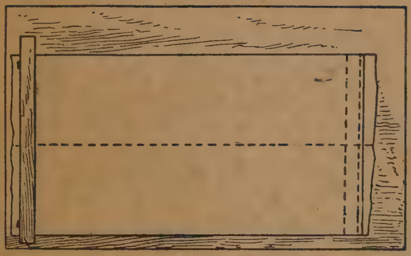


Fig. 7.—Cutting Blind Squarely

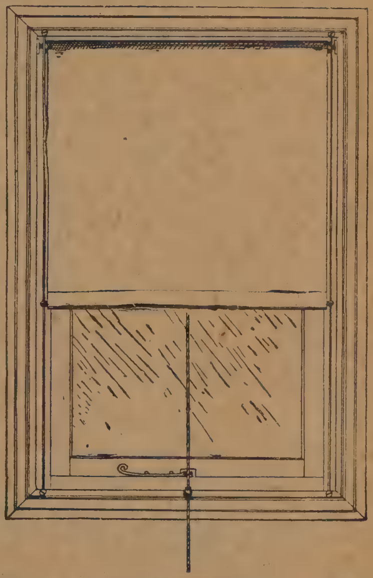


Fig. 10.—Skylight Fitted with Blind

The lath may then be put in and the blind rolled up from the bottom. The top edges of blinds are often hemmed for the roller, but if this is done it should fit tight. A simpler way is to mark a crease to turn back outwards ½ in. at the top edge. The roller should be 1 in. longer than the width of the blind. It is laid on with the spring end to the left and the folded edge drawn over and fixed in the groove with the steel nibs supplied with the fittings or with ¼-in. tacks (see Fig. 8).

The blind may then be rolled up the right way, and the tassel and cord put on by means of a metal tassel holder fixed with two ⅜-in. screws. It is then ready for fixing up, which is only a matter of screwing the two brackets in position to allow the blind to hang straight and even, and the roller to turn easily between them. The blind is placed in the brackets rolled up, and with the spring wound up for, say, two or three turns. When drawn down it winds up the spring in the roller, which will take the blind immediately back if it is not held for a few seconds to allow the check to act. The blind is run up and down by not giving the check time to act. It is easily got used to, but is not very well understood in general. After being in use some time the spring is apt to get weaker, and will not take the blind up to the top; then it should be lifted out of

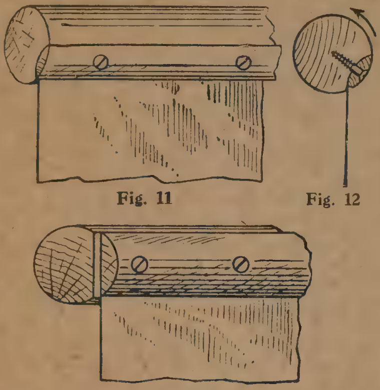


Fig. 11 Fig. 12 Fig. 13

Figs. 11 to 13.—Attaching Blind to Solid Roller by Means of Batten and Screws

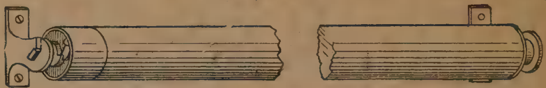


Fig. 14.—Spring Roller in Brackets

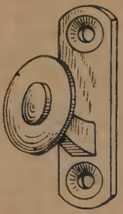


Fig. 15.—Young's Cord Holdfast

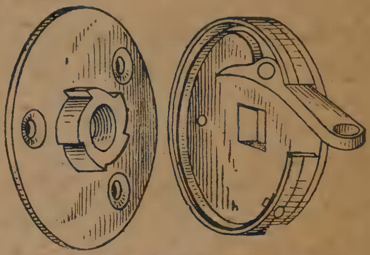


Fig. 16.—Brass Cap and Rack for End of Spring Roller

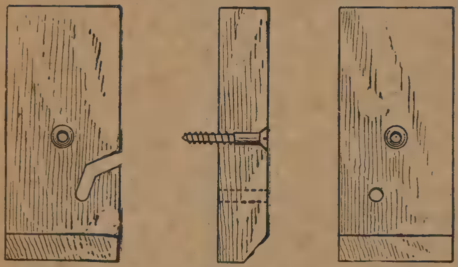


Fig. 17 Fig. 18 Fig. 19

Figs. 17 to 19.—Inside Blocks as Substitutes for Blind Brackets

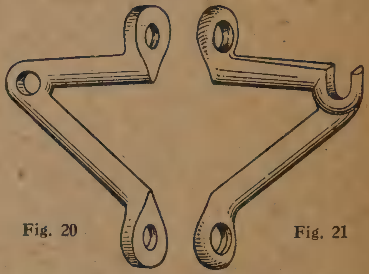


Fig. 20 Fig. 21

Figs. 20 to 25.—Various Patterns of Blind Brackets

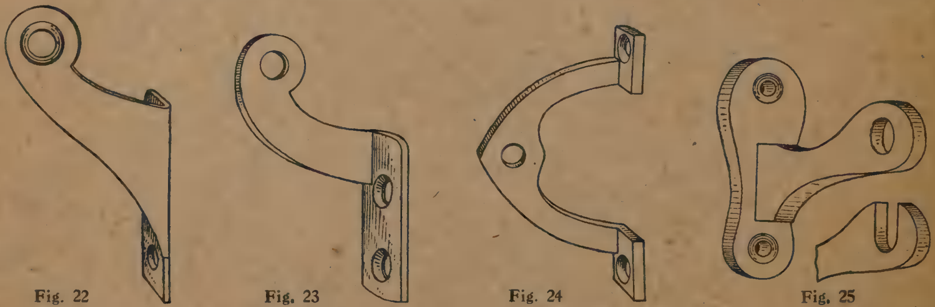


Fig. 22 Fig. 23 Fig. 24 Fig. 25

the brackets, rolled up by hand a foot or so, and replaced. This winds the spring a little tighter on being drawn down, and may be repeated several times if necessary.

The finished blind should fit the window as shown by Fig. 9. For bathrooms, kitchens, etc., acorns (see Figs. 24 and 25, p. 243) are preferable to tassels.

Fitting Blinds to Skylight.—It is sometimes necessary to fit a blind to a skylight, and this can be done very successfully, as shown by Fig. 10, which is a view looking up from the inside of the room. The blind in this case is 3 ft. by 2 ft.; but the drawing is made to a much larger scale than Fig. 9, to show the small detail. The measurement of the roller in this case is "pin measurement," that is, the full length from the tip of the pin at each end; and it must be the same as the width between the casing. The blind is made the same as for an ordinary window. Instead of the ordinary brackets, "pin-measurement" fittings are required, to be fixed as shown in Fig. 26. The diameter of the rolled-up blind is about 1¼ in., and its position is indicated by the dotted line circle. The left-hand fixing is shown put on to be level, not to be parallel with the sloping woodwork. It is essential with all spring rollers that the flat pin must be vertical in the bracket. When the blind is fixed up, it will hang down in the room, and it then becomes necessary to put a screw-eye in each end of the lath and to fix the cord at the centre. A small brass pulley is put at the centre of the lower casing mould, and the cord threaded through it. Two lengths of wire are next put through the screw-eyes, and the ends secured to the wood casing by coiling round the necks of screws, which are then driven home, as shown in Figs. 10 and 26. The blind will now work as on a window, but might be inclined to sag more or less according to the slope of the roof. To prevent this, the cord may be wound on a hook fixed at some convenient place. In some cases the cord is taken across the ceiling, and through another pulley and down the wall.

The above method has been carried out in shading a conservatory glass roof with blinds measuring 10 ft. long by 6 ft. wide. The blinds were put up in pairs, one under the other, with green and cream shades, so that either could be used at will. The arrangement proved very satisfactory. The rollers used were the usual 5 ft. long, by 1½ in. diameter, lengthened to 6 ft. 2 in.

A variety of fittings for spring and ordinary roller blinds is illustrated by Figs. 11 to 25.

When a spring roller fails to work properly it is common to rush to the conclusion that "the spring is broken." As a matter of fact, a spring scarcely ever breaks. Most likely, it requires to be strengthened by winding as previously described. Or, may be, the flat pin is too loose in the slot of the bracket, which requires closing up slightly or replacing by a new bracket. Very often the rollers are put out of working order by fixing on the shade with tacks. The working end of the roller is apt to rust, causing the thin metal cap to split off and prevent the check from acting. Experience proves that repairing and oiling give far more trouble than to replace with a new roller.

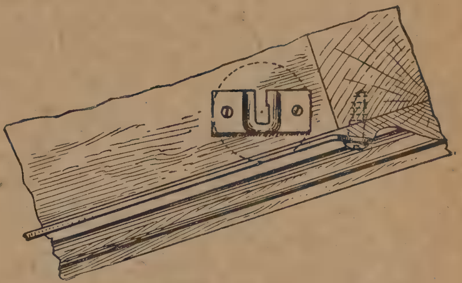


Fig. 26.—"Pin-measurement" Fitting

LATH ROLLER BLINDS FOR GREENHOUSES, ETC.

Lath roller blinds, as shown by Fig. 27, are excellent substitutes for mats in covering frames during the winter, and in protecting wall trees from frost when in flower. The spaces between the laths admit just the requisite amount of light. The sun's rays are diffused, and pass in broken succession over the plants in a way most beneficial to them, without burning the leaves.

The blinds are made of $\frac{7}{8}$-in. by $\frac{3}{16}$-in.

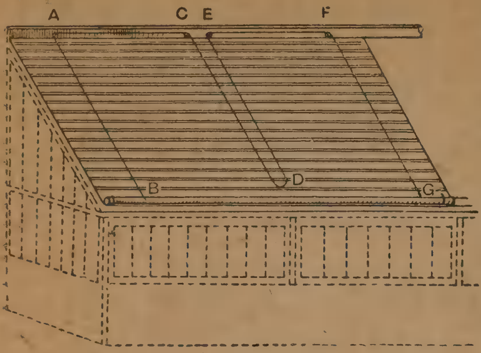


Fig. 27.—Greenhouse with Lath Roller Blind

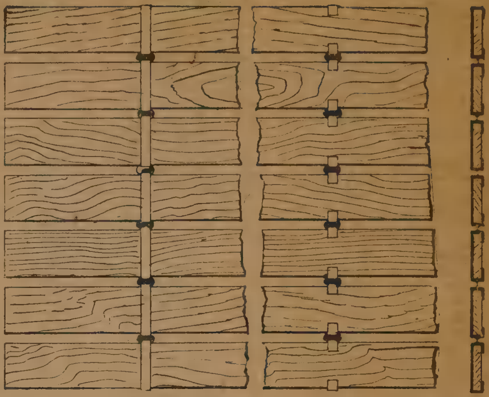


Fig. 28 Fig. 29 Fig. 30

Figs. 28 to 30.—Front View, Back View and Section of Blind

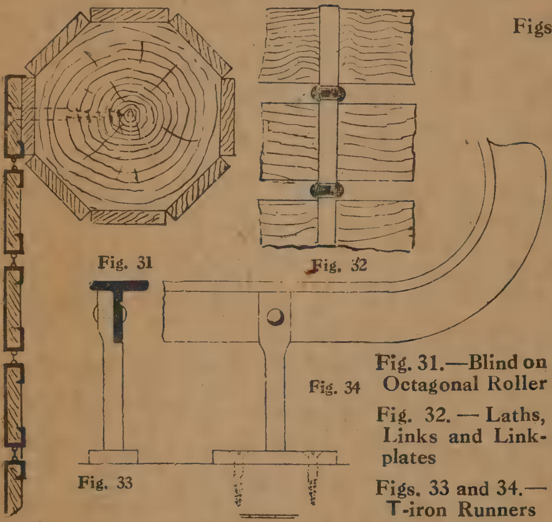


Fig. 31 Fig. 32 Fig. 33 Fig. 34

Fig. 31.—Blind on Octagonal Roller

Fig. 32.—Laths, Links and Link-plates

Figs. 33 and 34.—T-iron Runners

laths, connected at intervals of about 1 ft. 6 in., with iron link-plates and links, as shown in Figs. 28 to 32. The plate is slipped over the lath and clinched at the back as shown. The roller is of laths nailed to octagonal blocks, the blocks being placed at 2-ft. intervals, and attached to the blind as shown.

The roller, instead of being fixed at the ridge of the house, is worked by means of cords and pulleys as shown.

The top of the blind is a wide lath, 5 in. by 1 in., fixed to the top of the house by means of thumbscrews which are easily detachable.

The blind is opened and closed as follows: Fix the end of the cord underneath the pulley A (Fig. 27), pass it beneath the roller at point B, take it up on top through pulley A, then along to pulley C, down to D and up to pulley E; then along to pulley F, down to G, under roller at G, then under the blind beneath the pulley F, where the end must be fastened. By pulling the cord at the loop D the blind is rolled up. The T-iron runners (Figs. 33 and 34) are fixed to the principal rafters, and are turned up at the bottom end, as illustrated, with the object of preventing the roller running too far.

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